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WORKPLAN FOR BACKGROUND CHARACTERIZATION STUDY, QUESTA MINE, NEW MEXICO

(QUESTA MINE CLOSEOUT PLAN PROGRAM TASK A7 - SUBTASK 1.1 AND PHASE 2)

Prepared for

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1 INTRODUCTION

1.1 Terms of References

On September 21, 1999, Molycorp Inc. filed an application with the Mining and Minerals Division (MMD) of the Energy, Minerals, and Resources Department of New Mexico for extension of time for approval of a closeout plan for the Questa Mine, New Mexico, under Permit No. TA001RE. At the request of Molycorp, Robertson GeoConsultants Inc. (RGC) prepared a schedule for milestones and deliverables covering the period December 1999 until December 2001, the date of anticipated approval of the Closeout Plan. Molycorp submitted this schedule to the MMD in support of its time extension application on November 15, 1999. This schedule outlines the supporting studies and reports as well as the public review program required for preparation and submission of a Closeout Plan for the Questa Mine by January 31, 2001 (Appendix A). Molycorp's application for the time extension for approval of a Closeout Plan for the Questa Mine was approved by the MMD on December 30, 1999.

The submitted schedule provides for two work plans on the Background Characterization Study (Task A.7 of Work Schedule, see Table A1 of Appendix A) to be submitted to the MMD by January 31, 2000. The present workplan has been prepared on behalf of Molycorp to satisfy this requirement. Note that the two individual work plans listed in Table 1 (one for "Task 1.1 Reconnaissance Survey" and one for "Phase 2" of the Background Characterization Study) have been combined here into a single work plan.

1.2 Rationale for Background Study

Various studies have indicated a degradation (with distance downstream and with time) in stream water quality, and increased metal loadings in the sediments of the Red River in the reach between the town of Red River and the Ranger Station (downstream of the Questa Mine) (e.g. Slifer, 1996; Allen et al., 1999). Potential sources of acid rock drainage (ARD) considered in these studies that may contribute to this change in stream water quality include:

- Mineralized bedrock (including erosional scars) upstream of the Questa Mine;
- Mineralized bedrock (including erosional scars) within the Questa Mine area (either exposed or covered by mine rock material); and
- Mineralized mine rock piles and open pit.

The background study is aimed at quantifying the contribution of natural sources (mineralized bedrock including scar areas) located both upstream and within the mine area to the contaminant load (dissolved and particulate) to the Red River for pre-mining and current conditions. This assessment of the natural contaminant load to the Red River (from scar areas) will be required to (i) estimate pre-mining water quality in the Red River, (ii) quantify the current net impact of the Questa Mine, if any, on the Red River and (iii) evaluate the effectiveness of proposed Closeout Plan measures for reducing loads to values equivalent to or less than background.

1.3 Objectives of Background Study

The background characterization study has three principal objectives

- quantify the contaminant load generated from mineralized bedrock (erosional scars and adjacent mineralized areas), and the associated alluvial fans, in a background ("natural") watershed;
- determine key factors controlling the total contaminant load as well as its variations in time and space; and
- develop a generalized source model for mineralized bedrock (erosional scars and adjacent mineralized areas) in order to quantify the contaminant load from those areas located within the mine and Red River basin areas.

The following section outlines the approach of the background characterization study in more detail. The detailed work plan for the study is presented in Section 3.

2 APPROACH TO BACKGROUND STUDY

This section discusses the overall approach to the Background Characterization Study and illustrates how the results of this study will be used to develop an integrated geochemical load balance for the Red River Basin (see also Work Plan for Task A11: Comprehensive Water and Load Balance Study submitted under separate cover).

The background study consists of three parts reflecting the three principal study objectives:

1. Detailed characterization of selected background ("natural") watersheds with prominent non-mining scar areas resulting in a water and contaminant load balance for these drainages;
2. Comparison of contaminant loads from various scar areas to the scar geochemical and geotechnical characteristics in order to determine key factors (e.g. geochemistry of scar material; erodibility, runoff characteristics etc.) controlling natural ARD generation;
3. Development of a generalized source model for natural scar areas in order to estimate pre-mining, current and future loads from all natural scar areas within and outside the mine area but with the Red River catchment above the Ranger Station (Note: the development of the geochemical load balance for the mine area *per se* and the Red River Basin is covered in the Work Plan for Task A11: Comprehensive Hydrological Balance submitted under separate cover)

For the purpose of preparing this work plan a preliminary review of all available data has been completed. Based on this review a conceptual model has been developed of natural acid rock drainage (ARD) from non-mining scar areas (see below).

2.1 Conceptual Model of ARD Seepage from Scar Areas

2.1.1 ARD Generation in Scar Area

The scar areas represent outcrops of hydrothermally altered bedrock material that are significantly enriched in sulfide minerals. Within the scar areas this mineralized bedrock is exposed to oxygen resulting in oxidation of the sulfide minerals. As for sulfidic mine waste, the oxidation of scar material produces acidic water and elevated concentrations of sulfate and metals (i.e. "acid rock drainage" or ARD).

Figure 1 compares paste pH and paste conductivity values determined on samples from boreholes within a large scar within the mine area (i.e. SSB-1 and SSB-2 north of the open pit) and within three mine rock piles (WRD-1, WRD-7 and WRD-9). The paste pH of the scar material is typically around 3.5 and thus similar to that of the most acidic mine rock piles (e.g. WRD-9). Note that the strongly acidic conditions prevail to a significant depth (20ft in SSB-1 and 60ft in SSB-2). The fact that the low paste pH coincides with the presence of elevated levels of sulfate salts in the weathered scar material suggests that these acidic conditions are a result of in-situ oxidation (as opposed to washing down of ARD products). However, further geochemical (static and kinetic) testing on the scar material is planned to better understand the geochemical controls in the scar areas.

The paste conductivity of the scar material is in the order of 2000-4000 uS/cm (Figure 1). This range in paste conductivity is again very similar to the range of paste conductivity observed within the acid-generating mine rock piles (e.g. WRD-7 and WRD-9). The very low paste pH would suggest that the high conductivity of the scar material leachate is a result of highly elevated concentrations of ARD products (i.e. sulfate and metals). However, leach extraction tests on the scar material will be done in order to quantify the relative contributions of sulfate, various metals and other constituents within the leachate from the scar material.

The scar areas represent a highly erodable landform. The oxidation of the mineralized bedrock results in a break-up of the scar material ("chemical weathering"). Due to the steep terrain and continuing mass wasting, in the form of sheet and gully erosion, shallow slumps and landslides, vegetation can not establish itself. As a result, the fine material produced during chemical weathering is continually eroded by water during spring runoff and heavy summer rain showers. The erosive capacity of the scar areas has two important consequences for ARD generation. First, scar material is continually removed at the surface exposing new ("fresher") scar material (and sulfides) to the atmosphere. This mechanism provides for a continual supply of ARD source material at surface (even over geological time scales). Second, potentially acid-generating scar material is washed down in the form of a suspended load from the scar area. This eroded material can be coarse, including cobble and boulder sized particles (often referred to as "mud flow" or "debris flow") and may either be re-deposited in the alluvial fan of the scar watershed or enter the Red River (where it is ultimately deposited in the Red River alluvium). This re-deposited scar material represents a secondary source for natural ARD generation and will have to be characterized as part of this background study. Scar areas vary in intensity of hydrothermal alteration, and therefore also in the percentage of contained sulfides and weathering characteristics. The rate of erosion is also dependent on slope angle and length of slope. 'High grade' scars are highly erodable and devoid of vegetation while lower grade scars support sparse vegetation, and exhibit lower rates of erosion. A "low grade" scar may still be highly mineralized with the lower erosion resulting from lower slope angles and shorter slope lengths. The relative contributions of contaminants from the different high and low grade scar areas must be determined.

2.1.2 Runoff Model for Watershed with Prominent Scar Area

Figure 2 shows a conceptual runoff model for a background watershed with a prominent non-mining scar area. According to this model, the watershed can be subdivided into three distinct units:

- scar area (a subdivision between high and low grade scar areas may be required)
- non-scar area; and
- alluvial fan.

Each of these units differs with respect to its runoff characteristics as well as source loading. As outlined in section 2.1.1 above, the scar area is the primary source of ARD with the alluvial fan material representing a potential secondary source. Figure 2 also shows our preliminary estimates of the relative partitioning of precipitation into four different components:

- evapotranspiration;
- surface runoff;
- shallow groundwater flow in alluvial soils; and
- deep groundwater flow in bedrock.

The scar area is believed to generate a relatively high runoff (say 59% of all incoming precipitation) due to the typically steep terrain, absence of any vegetation and surface sealing of the clayey weathering products by rain drop impact effects. The evapotranspiration is estimated to be about 40% of all precipitation. Sublimation of the snow pack and possible wind blow of fresh snow may be substantial factors in the atmospheric removal of water from these barren scar areas. Residual soils are either very thin or absent and the underlying bedrock is likely of low to very low permeability limiting significant infiltration and deep groundwater flow.

The non-scar areas differ from the scar areas in sustaining relatively "dense" vegetation (for this semi-arid climate) that increases the potential for evapotranspiration. A comparison of mean annual precipitation (MAP) and mean annual runoff (MAR) for the Red River Basin suggests that only about 20% of all incoming precipitation reaches the Red River (at the Ranger Station), with the remaining 80% being returned to the atmosphere as evapotranspiration. An analysis of the baseflow of the Red River (i.e. incremental accretion to the Red River between Zwergle Dam and Ranger Station) suggests that about 60% of this yield (or 0.12 of total precipitation) represents surface runoff and 40% (or 0.18 of total precipitation) sustained groundwater flow. The contribution of deep groundwater flow through bedrock is likely very small relative to shallow flow through alluvial soils and the uppermost (weathered) layers of the bedrock.

The alluvial fan areas are characterized by relatively small surface gradients, permeable interlayered mud and gravel deposits and sparse vegetation. These factors, combined, are expected to result in evapotranspiration that is somewhat lower than on the (steeper but better vegetated) non-scar side slopes (say 0.7 of total precipitation). More importantly, alluvial fan areas are expected to be areas of net recharge with essentially all net precipitation and a significant proportion, say 50%, of all surface runoff infiltrating into the permeable deposits and becoming shallow groundwater flow. The infiltration of surface flow into the alluvial fan material is so significant that for example Hansen Creek commonly "dries up" for much of the year whereas surface flow from the scar areas in the headwaters of the Hansen Creek watershed are observed for most of the year.

Figure 2 illustrates that the relative contribution of runoff from the scar areas in a given watershed (both as surface flow and as alluvial groundwater flow) may be significantly greater than that of the non-scar areas. We emphasize that the estimates shown in Figure 2 represent only preliminary estimates for the purpose of discussion. Nevertheless, these estimates suggest that the runoff characteristics of a scar area (and its watershed as a whole) may differ substantially from the average response of forested head watersheds in the Red River Basin. One of the objectives of the proposed background study is to quantify the water balance of several "natural" watersheds with prominent scar areas in detail in order to develop an accurate load balance for this type of watershed.

2.1.3 Load Balance Model for Watershed with Prominent Scar Area

The load balance model for a watershed with non-mining scar areas is analogous to the water balance model presented in Figure 2. The load for any given "pathway" (designated in Figure 2 with an arrow) is calculated by the product of flow rate times the concentration (of a given contaminant) for a given time period (e.g. mean annual load in t/yr = mean annual flow rate (L/s) * average concentration (mg/L) * 0.0315 (conversion factor)).

The following issues need to be addressed when designing a field sampling program to measure the various contaminant concentrations for this load balance:

Dissolved load versus suspended load

We anticipate that the suspended load from scar areas represents a significant portion of the total load from a watershed containing significant scar areas. While suspended loads are likely limited to very few storm events per year (typically rain-on-snow or heavy summer thundershower events) these isolated events can move large amounts of contaminants in suspended form. The erosion gulleys and mudflow forms that are experienced and apparent on the alluvial fans indicate the substantial tonnages (and coarseness) of the solids that are transported during these isolated events. The timing and frequency of the monitoring and sampling program has to be designed in such a way that such extreme events are covered. In addition, contaminant concentrations should be determined both on filtered and unfiltered surface water samples to allow separate estimates of the suspended and dissolved load to be made.

Temporal Variability of Contaminant Concentrations

We anticipate that the contaminant concentrations in surface runoff from the scar areas (and to a lesser degree downstream) will vary significantly in time. On one hand an initial flushing of stored oxidation products may occur after extended periods of low flow (e.g. during on-set of snowmelt runoff or during a summer storm following a longer dry period) causing an increase in contaminant concentrations. On the other hand, large runoff events (e.g. late spring runoff) may result in some dilution of the contaminants owing to the large volumes of flow). Frequent water quality sampling (perhaps as frequently as daily) will be required during such critical events in order to quantify the temporal variations of contaminant concentrations and to allow a detailed load balance to be developed. Note that the temporal variability both in terms of flow rates as well as contaminant concentrations is likely much less pronounced for the groundwater components.

Geochemical Controls during Transport

The contaminant load is significantly complicated when the contaminant of interest reacts along the flow path. In the context of ARD the geochemical controls most commonly encountered are

- Redox reactions (e.g of iron, manganese and other trace metals);
- precipitation/dissolution reactions of metal hydroxides (e.g. $Al(OH)_3$) and other secondary minerals;
- buffering of acidic waters by calcite, dolomite and other minerals (e.g. feldspars)

- adsorption of selected contaminants (e.g. trace metals) in alluvial soils and bedrock fractures containing oxy-hydroxides.

These reactions may represent sources or sinks, depending on whether the contaminant concentration in question increases or decreases. The importance of the various geochemical controls for a given contaminant will have to be assessed as part of the loading balance. A combination of geochemical testing (of alluvial material) and geochemical equilibrium modeling (MINTEQA2 or PHREEQC) will be used in the proposed background study to quantify the effect of the various geochemical controls on the load balance from the background watershed. We anticipate that natural attenuation of ARD (buffering of pH and adsorption/precipitation of metals) within the alluvial soils will likely be exhausted considering that natural ARD from the scar areas has occurred for thousands of years.

The relative importance of geochemical controls on the loading of a given contaminant will be further assessed by comparing the loading balance of a non-reactive contaminant (e.g. sulfate in many ARD scenarios) to that of reactive contaminants (e.g. aluminum and other metals).

2.1.4 Groundwater Mixing in Red River Alluvium

As outlined in section 2.1.2 shallow groundwater flow through the alluvial fan deposit of the background watershed represents a significant pathway of contaminant load to the Red River. However, this subsurface contribution does not enter the Red River directly (except for perhaps some isolated springs at the Red River) but instead mixes first with the groundwater in the Red River valley alluvial infill. The physical and geochemical processes resulting from mixing of the ARD impacted debris fan groundwater and the well-buffered groundwater flowing within the alluvial aquifer of the Red River valley have to be understood.

Figure 3 shows a conceptual model of how the ARD impacted shallow groundwater originating from a watershed with prominent scar areas (using Hansen Creek as an example) mixes with the groundwater of the Red River Alluvium. Figure 3 illustrates that that these two types of groundwater do not mix instantaneously. Instead the mixing occurs progressively with increasing distance from the confluence. The distance required for complete mixing depends on the relative proportions of the two groundwater flows, the dispersivity of the Red River alluvial material, and the degree of mixing with the surface water of the Red River (in areas of groundwater discharge).

The mixing of the ARD impacted shallow groundwater and the groundwater in the Red River alluvium will be studied as part of the Hydrological Balance for the Red River basin (see Work Plan for Task A11 submitted under separate cover).

2.2 Preliminary Water and Load Balance for Watershed with Prominent Scar Areas

Based on the conceptual model outlined above a preliminary water and load balance has been developed for Hansen Creek. This watershed is one of the three candidate watersheds proposed for detailed monitoring in this Background Characterization Study (see Section 3). The purpose of this preliminary water and load balance for Hansen Creek was threefold:

- illustrate our approach to estimating the contaminant load originating from the natural scar areas,

- provide initial order-of-magnitude estimates of the contaminant load originating from the natural scar areas, and
- identify key components of the load balance which require more in-depth study in the proposed work scope.

Sulfate was used here for the load balance as a surrogate for ARD seepage. Sulfate is significantly elevated in ARD seepage and is relatively non-reactive thus significantly simplifying the load balance (see section 2.1.3).

2.2.1 Water Balance for Hansen Creek

Figure 4 shows the preliminary water balance for the Hansen Creek watershed. The numeric values represent the estimated mean annual flows for the various water balance components (in units of L/s). The mean annual precipitation (MAP) for the three units (scar area non-scar area and fan area) were derived from a (preliminary) regression of MAP as a function of elevation in the Red River basin (Figure 5). The estimate of total runoff from the non-scar areas was taken from the relationship of MAR versus elevation for the Red River (Figure 6). According to this preliminary water balance roughly half (~44%) of the total runoff from the watershed originates from within the scar areas. This preliminary water balance further suggests that the majority of runoff from Hansen Creek enters the Red River Valley system as shallow groundwater flow (~4.4 L/s) compared to ~2.5 L/s as surface flow (directly into the Red River) and ~0.2 L/s as deep groundwater flow.

These estimates compare favourably with order-of-magnitude estimates of groundwater flow at the confluence of Hansen Creek and the Red River (Figure 7). The groundwater flows were estimated using Darcy's Law and assuming hydraulic gradients equal to surface gradients as well as plausible estimates of cross-sectional areas and hydraulic conductivity (transmissivity). Note that the estimated flow of ARD impacted groundwater from Hansen Creek represents about 6-7% of the total groundwater flow in the Red River Valley alluvium.

2.2.2 Sulfate Load Balance for Hansen Creek

Figure 8 shows the preliminary sulfate load balance for Hansen Creek. For simplicity only the dissolved load balance is shown here. The values shown within the diagram represent (rough) estimates of average (dissolved) sulfate concentrations for the various components. A concentration of 3000mg/L was assumed for runoff from the scar area. Shallow runoff from non-scar areas and direct precipitation onto the alluvial fan area was assumed to pick up moderate sulfate levels (say 1000mg/L) from the scar material deposited in the alluvial fan. Background concentrations in surface runoff from non-scar areas were assumed to be 14 mg/L as observed in the headwaters of tributaries of the Red River Basin lacking any scar areas (c. Figure 10).

The mean annual sulfate load (listed by flow component and contributing area) are tabulated at the bottom of Figure 8. The total sulfate load to the Red River system is an estimated 375 tonnes/year. An estimated 75% of this sulfate load originate from the scar areas with most of the remaining load originating from the material deposited in the alluvial fan area. The preliminary load balance suggests that almost 2/3 (~63%) of the total sulfate load from the Hansen Creek watershed to the Red River System is delivered by groundwater flow and only 1/3 by surface flow directly into the Red River.

It is emphasized again that these estimates of sulfate loads from scar areas to the Red River are very preliminary. The overall objective of the Background Characterization Study is to refine this load balance for three "natural" watersheds impacted by large scar areas (i.e. Hansen Creek, Straight Creek and Hottentot Creek) and to develop a generalised source model that allows extrapolation of the findings from these "natural" watersheds to other watersheds with scar areas. The latter aspect of the Background Characterization Study is briefly discussed below.

2.3 Integration into Loading Balance for Red River Basin

The ultimate goal of the background study is to quantify the contaminant load from the scar areas, which are situated within the Questa mine area, for pre-mining, current and post-closure conditions. Figure 9 shows the areal extent of the natural (high grade) scar areas within the Questa mine area prior to mining (mapped from pre-mining air photos). The natural scars within the mine area cover a surface area of approximately 327 acres (132ha). For comparison, all scar areas located upstream of the mine area combined (including Hansen Creek) cover a total surface area of about 351 acres (142ha). The scar areas in Hansen Creek represent about 20% (i.e. 70 acres or 28ha)) of those scar areas upstream of the mine.

There is no pre-mining water quality data available for streams draining the mine area with large scar areas (Capulin, Goathill, and Sulfer/Spring Gulch). Hence, the pre-mining contaminant load originating from the scar areas within the mine area will have to be estimated using load estimates for the scar areas upstream of the mine. As a first approximation the contaminant load can be pro-rated using the surface area of the natural scar areas.

A preliminary estimate of the pre-mining sulfate load from the natural scars within the mine area has been made to illustrate this approach. The contaminant load produced from natural scar areas (upstream of the mine) has been estimated in two independent ways. First, a detailed (preliminary) load balance has been developed for the Hansen Creek watershed (see section 2.2.2). The total annual sulfate load was estimated to be about 375 t/yr. Assuming Hansen Creek is representative of other natural scar areas the average sulfate yield from a scar area is about 5.5 t/yr per acre of natural scar area. For a 3% sulfide content in the scar material this represents an erosion rate of about one foot in fifty years in order to expose new sulfides to maintain this yield rate.

The second approach to estimating the sulfate load from the natural scar areas is to calculate the sulfate load in the Red River from mean annual runoff (MAR) and median average sulfate concentrations. According to the USGS the median sulfate concentration in the Red River (surface water) just upstream of the mine is about 66 mg/L (median of 24 samples sampled from 1979-82, see Figure 10). With a MAR at this location of about 1020 L/s the total annual sulfate load is about 2100 t/yr. The contribution of non-scar areas to the total sulfate load is estimated to be about 400 t/yr (assuming a background sulfate concentration of 14 mg/L, see Figure 10). Hence the remaining 1700t/yr would originate from the scar areas upstream of the mine resulting in an area pro-rated yield of 4.8 t/yr per acre of natural scar area. This sulfate yield estimate compares favourably with our estimate of 5.5 t/yr/acre for Hansen Creek.

However, the latter load estimate does not consider the sulfate load to the alluvial aquifer in the Red River Valley (see Figure 3). Preliminary estimates indicate that the sulfate load carried with the groundwater flow in the valley aquifer is substantial. Groundwater flows in the alluvial aquifer are estimated to be in the order of 100 L/s or greater depending on local aquifer permeability and cross-sectional area of the aquifer. (Note that the extraction rates of alluvial groundwater for mill water supply from the Mill wells and Columbine wells combined are as high as 160 L/s). Assuming a sulfate concentration of 400 mg/L for the groundwater in the Red River alluvium (typical sulfate concentration for Mill wells) the sulfate load in the groundwater of the Red River Valley would be about 1200 t/yr (i.e. about 57% of the surface water load). At a 3% sulfide content this represents an additional erosion rate of about another 6 inches in 50 years for a total erosion rate of about 18 inches per fifty years.

Figure 9 shows a preliminary pre-mining sulfate load balance for the entire Red River basin (to the Ranger Station) using the Red River load estimates and assuming that the sulfate load is proportional to surface area of the "high grade" scar areas alone. Based on this analysis the high grade scar areas in the mining area would have contributed an average of 2400 t/yr or about 40% of the total load to the Red River system (surface and groundwater combined) prior to large-scale mining.

Note again, that the preliminary sulfate load balance shown in Figure 9 uses long-term average flow rates and median concentrations for the period 1979-1982. The actual annual loading to the Red River will vary from year to year due to variations in annual precipitation. Figure 11 shows the cumulative difference in stream flow from the long-term mean annual flow for Cabresto Creek and the Red River at the Ranger Station. This plot illustrates the long-term trends of wetting and drying cycles over the last 70 years. Note that we are currently in a wet cycle with erosion rates and stream flows well above long-term average. It is likely that such climate cycles influence the annual loading from natural sources. For example, it is likely that after a longer dry cycle the first wet years will produce above average loads from the erosional scars due to initially accelerated rates of erosion and flushing of the stored oxidation products. The results of the background study (monitored in detail for at least one full year) will have to be interpreted in the context of long-term climate fluctuations.

In the simplified pre-mining load balance (Figure 9) it was assumed that all high grade scar areas yield about the same amount of sulfate (as a function of surface area). The background study aims at identifying key factors that relate the source strength of a scar area to its contaminant yield. Potentially important factors influencing the yield from the scar areas (other than surface area) include:

- degree of mineralization;
- infiltration capacity;
- topography (slope angle and length);
- erodibility of weathered rock (hence rate of erosion);
- elevation.(hence precipitation and type of vegetation), and
- anthropogenic acitivity.

3 WORK PLAN

The following work plan outlines the scope of work for the background characterization study covering the period February 2000 to May 2001. In general, this work plan follows the scope of work outlined in Molycorp's earlier submittal (July 1998). However, some changes have been made to the earlier submittal due to a review of existing data (section 2) and discussions with the NMED and Technical Review Committee. The most important changes to the original workplan include detailed monitoring in three (rather than only one) background watersheds and significant expansion of the groundwater monitoring program. In addition, Phases 1 and 2 of the background study will now be completed simultaneously to complete the studies in the required time frame.

3.1 Phase 1 of Background Study

Task 1.1. Reconnaissance Survey

A reconnaissance survey will be made of all scar areas within the Hansen Creek, Straight Creek and Hottentot Creek watersheds located upstream of the mine area (Figure 12). Molycorp will use air photo interpretation and a ground survey (with GPS) to develop a visual description of the scar areas and limits. The reconnaissance survey will include field measurements of paste pH and paste conductivity on representative samples of scar material and other natural soils. Any evidence of anthropological activity, particularly mining, exploratory drilling, road building and logging will be described and quantified.

In each of the three prominent scar areas of the study watersheds (i.e. Hansen Scar, Straight Creek Scar, and Hottentot Scar, see Figure 12) approximately 10 to 15 samples of representative scar material will be taken for laboratory testing. The majority of these samples will be taken from the near-surface as grab samples (by hand or using a backhoe). In addition, scar samples from greater depth may be obtained by drilling using test pitting or hand augering (to the extent practical). All scar samples will be submitted to a specialist laboratory for the determination of whole rock analysis, ABA values and Nevada meteoric water extraction tests.

In addition, soil loss gauging stations (marked staff gauges) will be installed across the prominent scar area of each study watershed. These gauges will be read semi-annualy to determine the average rate of erosion of scar material.

The drainage system and pattern will be determined from air photo and ground reconnaissance survey. Based on this analysis suitable monitoring stations will be selected to enable water quality and flow rates to be determined at key points between the head of the creek and just upstream of the confluence of the creek with the Red River (say 3-4 stations per watershed). These surface water monitoring stations will be selected, marked with flagged stakes and a photographic record taken.

Task 1.2 Determination of Historical Landuse

Molycorp will conduct a literature search and investigation to determine (to the extent practical) the extent of anthropological activity that has occurred on, and surrounding, the scar areas.

Based on this review and evidence from the field reconnaissance Molycorp will assess the extent to which anthropological activities may influence ARD from any given scar area.

Task 1.3 Surface Water Monitoring

The surface water monitoring network will consist of 4 primary stations and 4 secondary stations distributed over the three "natural" watersheds (Hansen Creek, Straight Creek, and Hottentot Creek). Figure 12 shows preliminary locations for these surface water monitoring stations in the three study watersheds (to be confirmed after the reconnaissance survey). The primary stations are located (1) at the base of the prominent scar area (where the stream channel is typically carved directly into bedrock) and (2) near the confluence of Straight Creek with the Red River (just upstream of the road and culvert). The secondary stations are located along the main drainage channel between the two primary stations in Straight Creek and near the confluence of Hanson Creek and Hottentot Creek with the Red River (just upstream of the road and culvert).

At each primary station a V-notch weir and/or a Parshall flume will be installed to allow accurate flow measurements to be taken (assuming permission is granted by the U.S. Forest Service). The culverts crossing the state road provide a convenient backup for estimating flows during peak runoff events. In addition, an all-weather rain gauge (with data acquisition system) will be installed at the two primary stations of the middle watershed (Straight Creek). The precipitation data from these two stations will be complemented with a survey of snow depth and water equivalent in the Straight Creek watershed just prior to snowmelt runoff. The snow course will consist of 10 points each across the alluvial fan and barren scar area, respectively.

The program for surface water monitoring/sampling is divided into four parts:

Part 1 – Routine monitoring at primary stations. Monitoring of flow, field parameters (e.g. pH, and conductivity) as well as sampling for laboratory analysis of a comprehensive range of total and dissolved contaminants (see below) will be done on a weekly basis during high flow (April – August) and every two weeks during low flow (September – March) at about the same time each day.

Part 2 – Episodal monitoring at primary stations. To determine changes in flow rates (and water quality) resulting from diurnal and seasonal changes as well as precipitation events, there will be periodic more frequent (possibly hourly) measurements to determine the variation patterns. This intense monitoring will be done at least in one watershed (Straight Creek). To the extent practical this intense monitoring will also be extended to the primary stations in the other two watersheds (Hansen Creek and Hottentot). The frequency, or time periods at which this monitoring will be done will be designed to be sufficient to establish these characteristic flow variations. This monitoring will be primarily done using quick field parameters such as pH and conductivity. A sufficient number of water samples will be taken (for chemical analysis) to allow changes in water quality associated with changes in flow regime to be assessed.

Part 3 – Routine monitoring at secondary stations. Regular monitoring (but less frequent than for the primary stations) will be performed at the secondary stations. Such monitoring may occur at weekly intervals during high flow or rapidly changing periods, and monthly at other times. Little or no monitoring may be required during winter months, when surface flow dries up or access to the secondary stations may be severely restricted. The monitoring and sampling would be similar to that for Part 1.

Part 4 – Episodal monitoring at secondary stations. Irregular monitoring and sampling would be done at all stations to measure flow and water quality conditions at times of interest, such as:

i. Early spring freshet;

ii. High and low flow periods; and

iii. After severe thunderstorms.

In addition to the above, a descriptive record and photographic log will be prepared, which will provide an illustrated record of monitoring stations conditions, erosion and debris flows during the field visits made for this program.

The water samples will be taken using a peristaltic pump. Prior to sampling stream water will be pumped through a flow-through cell fitted with probes for about 10 minutes or until pH and conductivity have stabilised. After stabilisation filtered samples will be collected using in-line filtration through a 0.45 um Gelman capsule (or equivalent). At selected times (~10% of all sampling runs) unfiltered samples will be also be taken (for total metals analysis). Acid washed polyethylene bottles will be used for collection of all samples.

The water quality parameters to be measured include relevant field parameters (pH, electrical conductivity, and temperature), Ca, Mg, Na, K, SO_4, Cl, HCO_3, F, alkalinity/acidity, and the metals of interest (Al, Fe, Mn, Cd, Co, Cu, Ni and Zn). Samples for metals analysis will be preserved with HNO3 to pH <2. Samples for anions will be transported to the lab on ice and kept under refrigeration until analysed. Equipment blanks and field replicates (~5% of all samples) will be collected to check for contamination and reproducibility. Sample containers will be sealed in the field and chain-of-custody procedures will be employed for all samples.

The majority of field monitoring and sampling will be performed by a graduate student from the University of New Mexico (Supervisor: Dr. Bruce Thomson, Civil Engineering Dept.) thus providing consistency in the data collection. The water quality analyses will be performed by an accredited laboratory, which employs standard QA/QC procedures (see Appendix B for proposed analysis methods, detection limits and sample handling procedures).

Task 1.4 Report on Background Characterization of Surface Water from Non-mining Scar Affected Areas

Molycorp will submit a report that describes the field program and summarizes the results of the surface water monitoring and sample analyses completed up to August 31, 2000 (see section 3.3 for schedule and submission dates). The data analysis will include a preliminary hydrological model for the catchments above monitoring stations, allowing first estimates of annual surface flows and contaminant loads to be made. This hydrological model will be refined as more data become available (see Task 2.5).

3.2 Phase 2 of Background Study

Task 2.1 Ground Water Reconnaissance Survey

Molycorp will perform a reconnaissance survey along both banks of the Red River over the reach where contaminated drainage from the 'natural drainages' (Hansen, Straight and Hottentot) is expected to discharge to the Red River. This survey would be done during a low flow period for the Red River when the potential for detecting seeps is greatest. Any seeps located will be described, photographs taken, and samples of seepage water collected and analyzed for contaminant constituents.

Ground geophysical techniques will be employed to characterize the bedrock topography and identify preferred pathways of ARD impacted groundwater in the lower portion of the alluvial fan area. Seismic profiles will be run across the lower scar area of all three watersheds to delineate the bedrock topography (see Figure 13 for proposed location). In addition, an electromagnetic (EM) survey will be run along one of these survey lines in an attempt to localize shallow groundwater with high electrical conductivity (i.e. impacted by ARD). If results of the EM survey are found to provide definitive results of acidic plume locations the EM survey will be run at all seismic profile locations.

Using the results from the seep survey, the geophysical survey and a site reconnaissance, suitable locations will be selected and flagged for drilling and installation of monitoring wells.

A test pit program will also be conducted to determine the physical and geochemical characteristics of the alluvial fan material. A minimum of five test pits will be dug in the alluvial fan area of each background watershed (provided permission is granted by the U.S. Forest Service). Test pits will be dug to a depth of about 2-3m using a backhoe. The test pit wall will be photographed and logged with respect to layering, grading, texture and presence of water, macropores and rooting depth. Representative grab samples covering the range of geochemical and physical soil types will be taken from the test pit face and described in the field with respect to chemical composition (lithology, paste pH, paste conductivity) and physical appearance (color, texture, visual estimate of grain size distribution). Selected samples will be bagged in air tight plastic bags and shipped to a specialist laboratory for either physical and/or geochemical characterization. Physical testing will include grain size analysis and saturated permeability testing. Geochemical testing will include whole rock analysis, ABA values and Nevada meteoric water extraction tests.

Infiltrometer tests will be carried out using a ponded infiltrometer and/or performing a large-scale infiltration test within the test pit. In the latter method the test pit will be filled with water, allowed to drain over night and refilled the next day. The subsequent fall in the water level in the pit can be used to estimate the bulk permeability of the material (Porchet method).

An attempt will be made to characterize the rate of deposition of alluvial material (predominantly from scars) in the alluvial fan area. Staff gauges will be driven into the ground (or affixed to trees) in the area of active deposition (near the current creek bed(s)) and the change in sediment height monitored over time. Where possible the rate of historic deposition will be assessed by dating trees which have been partially buried by historic mud flows.

Task 2.2 Ground Water Quality Monitoring

Figure 13 shows preliminary locations for the groundwater monitoring stations in the three study watersheds (to be confirmed after the reconnaissance survey). Two monitoring wells will be drilled just downstream of the prominent scar area of each watershed to monitor groundwater flowing from the scar area. One well will be completed in the alluvial soils (if present) and one in the underlying bedrock. (If no alluvium is present both wells will be completed in bedrock). The shallow well will be screened across the water table and the deep well(s) will be screened in the bedrock aquifer (in the upper 20 ft of the bedrock aquifer but not more than a 100ft total depth). In the fan area a fence of 3-5 shallow monitoring wells, oriented roughly parallel to the Red River, will be completed to monitor groundwater flowing within the alluvial soils. These shallow wells will be drilled down to bedrock or 15ft below the groundwater table, whichever comes first. At the central location of each fence of wells, a second, deeper borehole will be completed to monitor groundwater flow within bedrock. These deep wells will be drilled at least 30ft into bedrock but no more than 150ft total depth.

The installation of the monitoring wells will be done in accordance with the NMED guidelines for the construction of monitor wells, and supervised by a qualified geologist and/or hydrogeologist. All monitoring wells will be single installations (one screen per hole) using 2-inch diameter PVC casing (Schedule 40) and 20ft screen lengths (longer screens might be used in areas where larger variations in water levels are anticipated). All wells will be completed using appropriate filter pack material, bentonite seals and cement-grouting of the annulus to surface and will be developed (purged) prior to initial sampling.

Groundwater levels will be measured in all monitoring wells at least once a month (and more frequently if large variations are observed). Water quality samples will be taken from all monitoring wells quarterly for a period of one year to establish seasonal variations. An additional sampling round will be done during, or immediately after peak snowmelt runoff. The groundwater samples will be taken using a portable pump. Prior to sampling groundwater will be pumped through a flow-through cell fitted with probes until pH and conductivity have stabilised (purging at least three well volumes). After stabilisation, filtered samples will be collected using in-line filtration through a 0.45 um Gelman capsule (or equivalent). Acid washed polyethylene bottles will be used for collection of samples. The water quality parameters to be measured include relevant field parameters (pH, electrical conductivity, and temperature), Ca, Mg, Na, K, SO_4, NO_3, Cl, HCO_3, F, alkalinity/acidity, and the metals of interest (Al, Fe, Mn, Cd, Co, Cu, Ni and Zn). Samples for metals analysis will be preserved with HNO3 to pH <2. Samples for anions will be transported to the lab on ice and kept under refrigeration until analysed. Equipment blanks and field replicates (~5% of all samples) will be collected to check for contamination and reproducibility. Sample containers will be sealed in the field and chain-of-custody procedures will be employed for all samples.

The water quality analyses will be performed by an accredited laboratory, which employs standard QA/QC procedures (see Appendix B for proposed analysis methods, detection limits and sample handling procedures).

Depending on the results of Task 2.1, any contaminated seeps which appear to be associated with contaminated drainage from the 'natural drainages' will also be monitored and sampled on a quarterly basis for one year to establish the seepage rate and water quality variation.

Task 2.3 Report on Background Characterization of Ground Water from Non-mining Scar Affected Areas

Molycorp will submit a report that describes the well installation program and summarises the initial results of the groundwater monitoring (water level monitoring and water quality results) completed up to June 15, 2000 (see section 4 for schedule and submission dates). The report will include a preliminary hydrogeological model for the three watersheds, allowing first estimates of annual groundwater flows and contaminant loads to be made. This hydrogeological model will be refined as more data become available (see Task 2.5).

Task 2.4 Reconnaissance Survey of All Scar Areas

Molycorp will perform a reconnaissance survey at all scar areas in the Red River catchment between Red River and the Ranger Station (including those of the mine area not currently covered by mine rock). This reconnaissance will be based on air photo interpretation and traverses on the scars with measurements of paste pH and conductivity. In addition, samples will be taken from the major (exposed) scar areas located within the mine area and submitted to a specialist laboratory for geochemical testing (whole rock analysis, ABA tests and Nevada meteoric water extraction tests). The results of the geochemical testing from scar areas within the mine site will be compared to those from scar areas in the "natural drainages".

The results of this basin wide reconnaissance will be compared with the results from the more detailed surveys for the scars in the 'natural drainages' (Hansen, Straight, Hottentot). Based on this comparison the various scars in the Red River watershed will be ranked according to their potential for ARD generation (likely at a scale from 1-5). The ranking will be based on geochemical characteristics (paste pH/conductivity) as well as other factors (e.g. slope, elevation, vegetation). A map of scar type and grade will be prepared. The map will include the drainages and scar areas on the Questa mine site.

Task 2.5 Report on Background Watershed Contaminant Load Model

The results of the surface water and groundwater monitoring program and characterization of the individual scar areas will be combined to develop a contaminant load model for watersheds with non-mining scar areas. First, the preliminary models of surface flow (Task 1.4) and groundwater flow (Task 2.3) will be refined using the most recent field data (up to November 2000). These models will be used to estimate monthly and total annual flows of surface water and groundwater.

Second, contaminant concentrations in surface water and groundwater will be correlated with flow conditions and seasons. Based on this analysis the natural annual variations in contaminant concentrations and loads will be estimated.

Finally, using the specific contaminant yield values for the three natural drainages, together with the estimates of scar type and grade values from Task 2.4, the contaminant loads from all scar areas will be estimated. By introducing these loads into a hydrological/geochemical model for the Red River, the concentrations of contaminants in the Red River can be calculated (see work plan for Comprehensive Water and Load Balance Study). The rationale and development of the contaminant load model for all scar areas will be documented in a report.

3.3 Schedule and Deliverables

The schedule for the proposed work plan is outlined in Table A1 of Appendix A. The deliverables and dates of submission are summarized in Table 1 below.

Table 1. Deliverables for Background Study.

Deliverable	Date of Submission
Report on Background Characterization of Groundwater	July 17, 2000
Report on Background Characterization of Surface Water	October 16, 2000
Report on Contaminant Load Model from Background Watersheds	December 15, 2000

4 REFERENCES

Allen, B.D., A.R. Groffman, M.C. Molles Jr., R.Y. Anderson, and L.J. Crossey, 1999, Geochemistry of the Red River stream system before and after open-pit mining, Questa area, Taos County, New Mexico, Final Report prepared for the New Mexico Office of the Natural Resources Trustee, October 1999.

Slifer, D., 1996, Red River groundwater investigation, New Mexico Environment Department (SWQB), Report prepared for the USEPA Region VI, 1996.

Figures

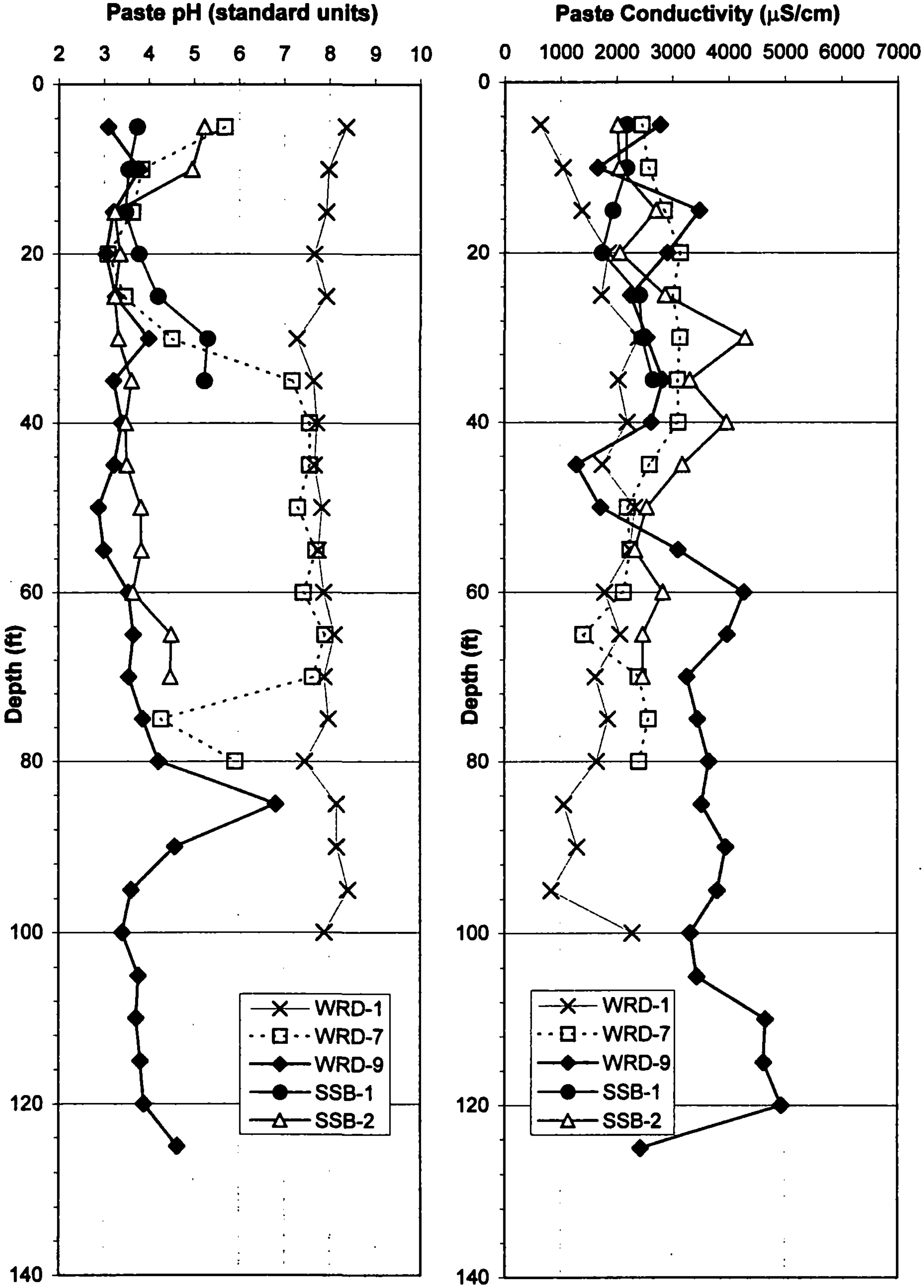
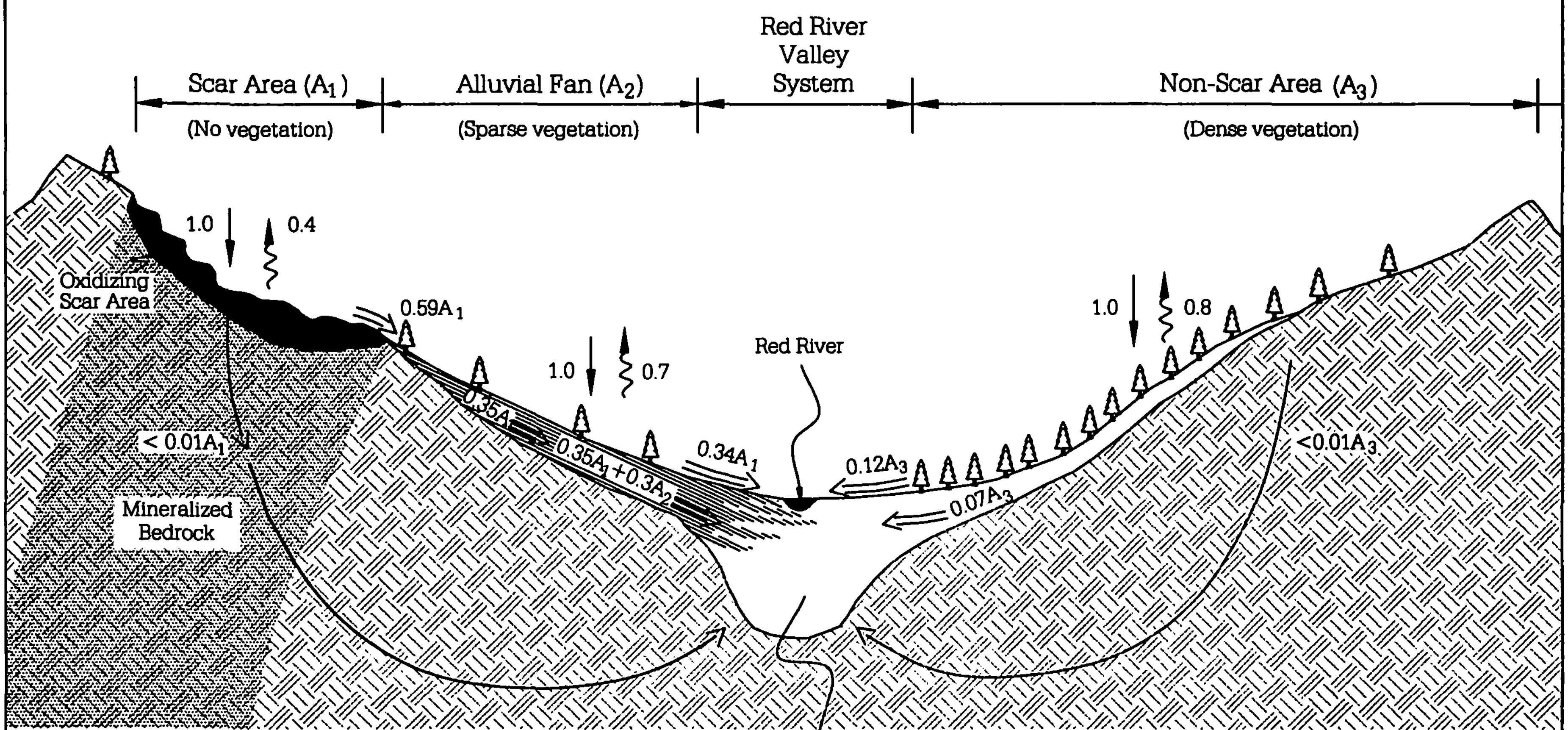


Figure 1. Comparison of Paste pH and Conductivity of Natural Scar Material and Waste Rock



LEGEND

- Precipitation
- Evapotranspiration
- Surface Runoff
- Groundwater Flow in alluvial soils
- Groundwater Flow in bedrock

Note: all estimates are preliminary and will be verified by field work

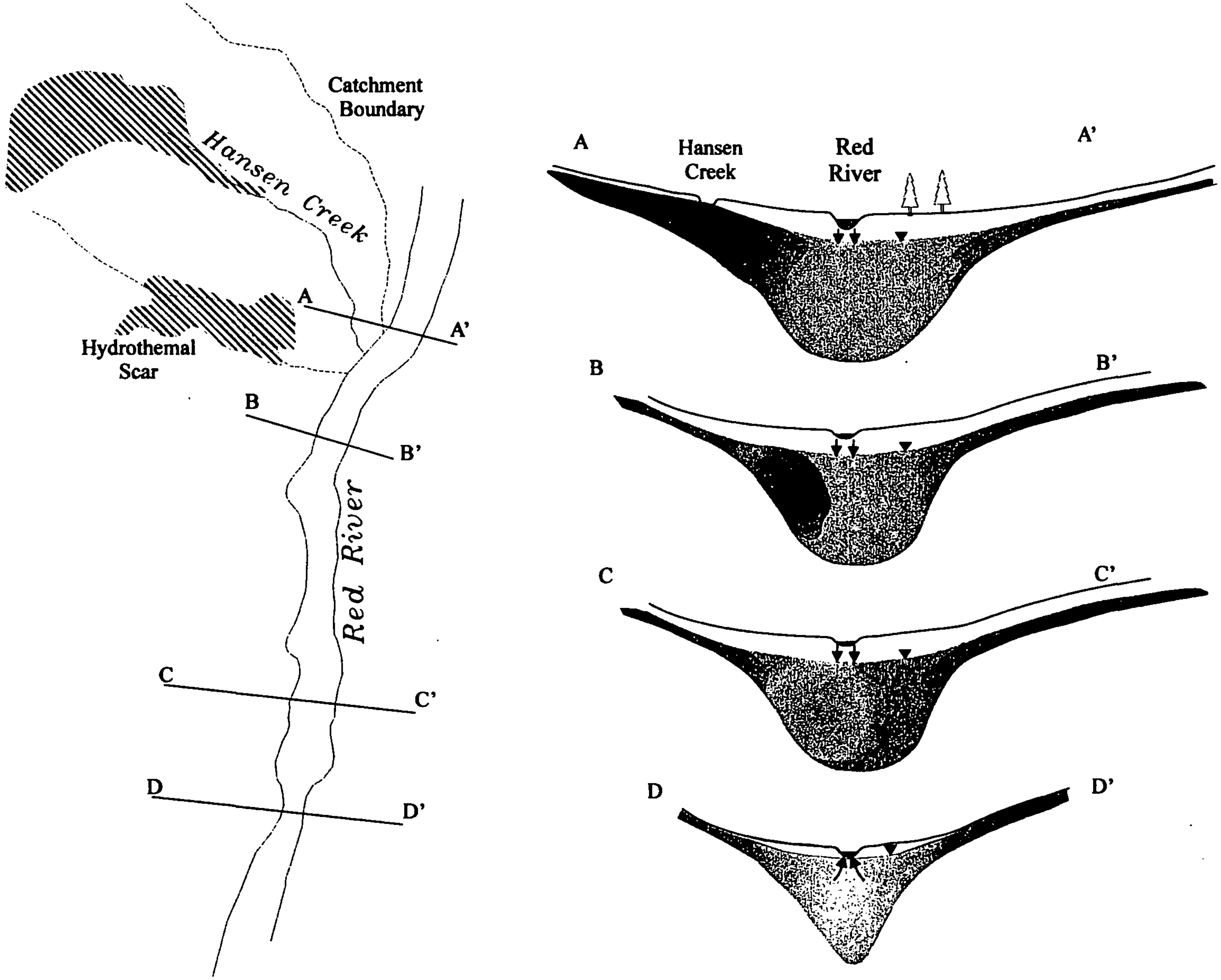
Flux to Red River Valley System	
Red River:	$0.34A_1 + 0.12\,A_3$
Red River Alluvium:	$0.35A_1 + 0.3A_2 + 0.07A_3 + 0.01A_1 + 0.01A_3$

CLIENT:	MOLYCORP, INC.
PROJECT No:	052008
PROJECT:	QUEASTA CLOSEOUT PLAN
LOCATION:	QUESTA MINE NEW MEXICO, USA

ROBERTSON GEOCONSULTANTS INC.
Consulting Geotechnical and Environmental Engineers

Conceptual Runoff Model
(values shown are unit flow rates relative to precipitation)

DATE:	DRAWN BY:	FIGURE:
Jan. 2000	JG	2



CLIENT:	MOLYCORP, INC
PROJECT No	052008/1
PROJECT:	QUESTA CLOSEOUT PLAN
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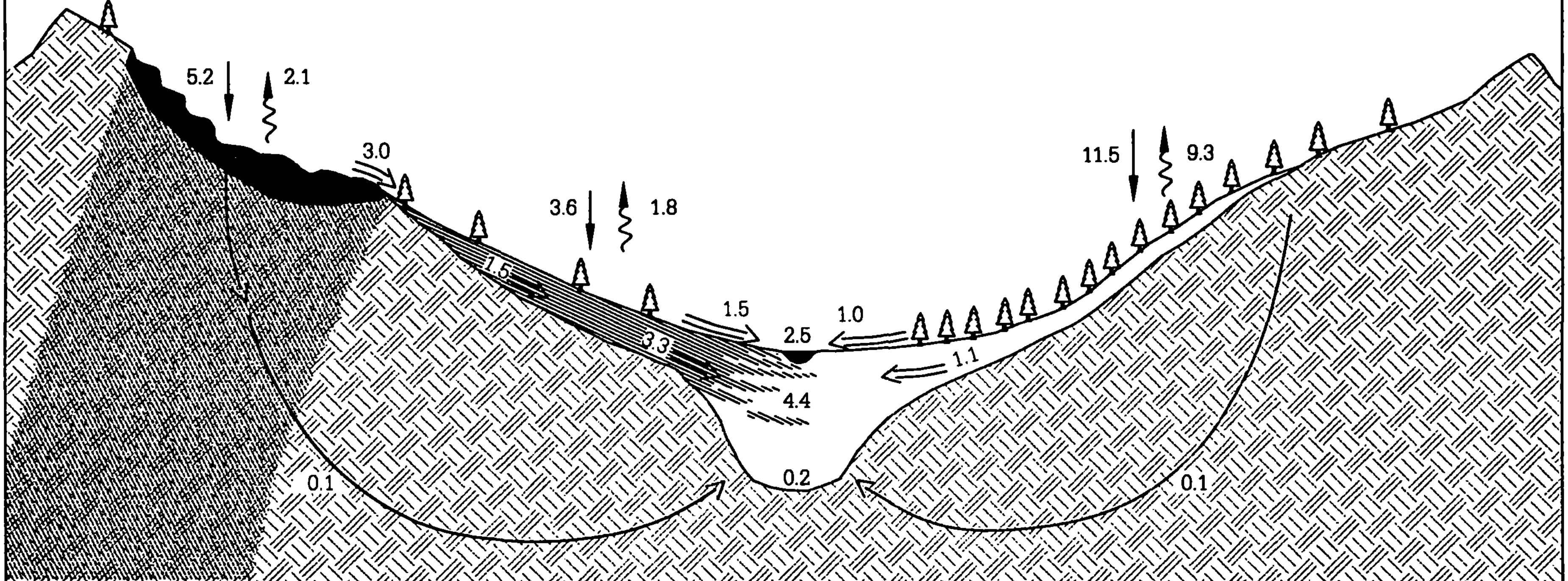
Conceptual Model of ARD Impacted Groundwater Mixing with Groundwater in the Red River Alluvium

DATE:	DRAWN BY:	FIGURE:
Jan. 2000	JG	3



Scar Area	Fan Area	Non-Scar Area
$A = 0.28\ km^2$	$A = 0.24\ km^2$	$A = 0.68\ km^2$
MAP = 23" (5.2 L/s)	MAP = 19" (1.8 L/s)	MAP = 21" (11.5 L/s)

Note: all estimates are preliminary and will be verified by field work

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Hanson Creek - Local Water Balance
(values shown are mean annual flows in L/s)

DATE:	DRAWN BY:	FIGURE:
Jan. 2000	JG	4

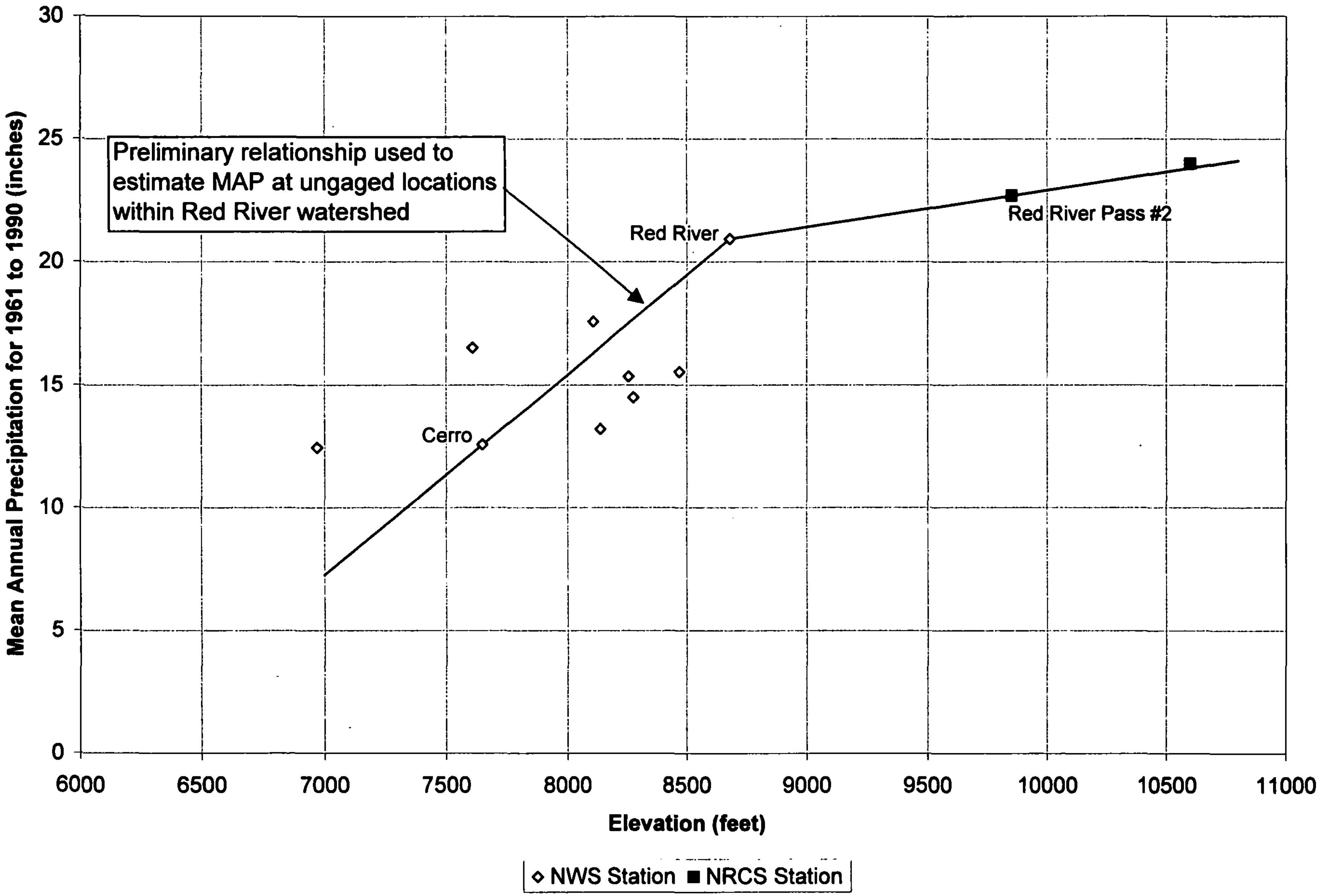


Figure 5. Regional Relationship Between MAP and Elevation

Robertson GeoConsultants Inc
January 2000

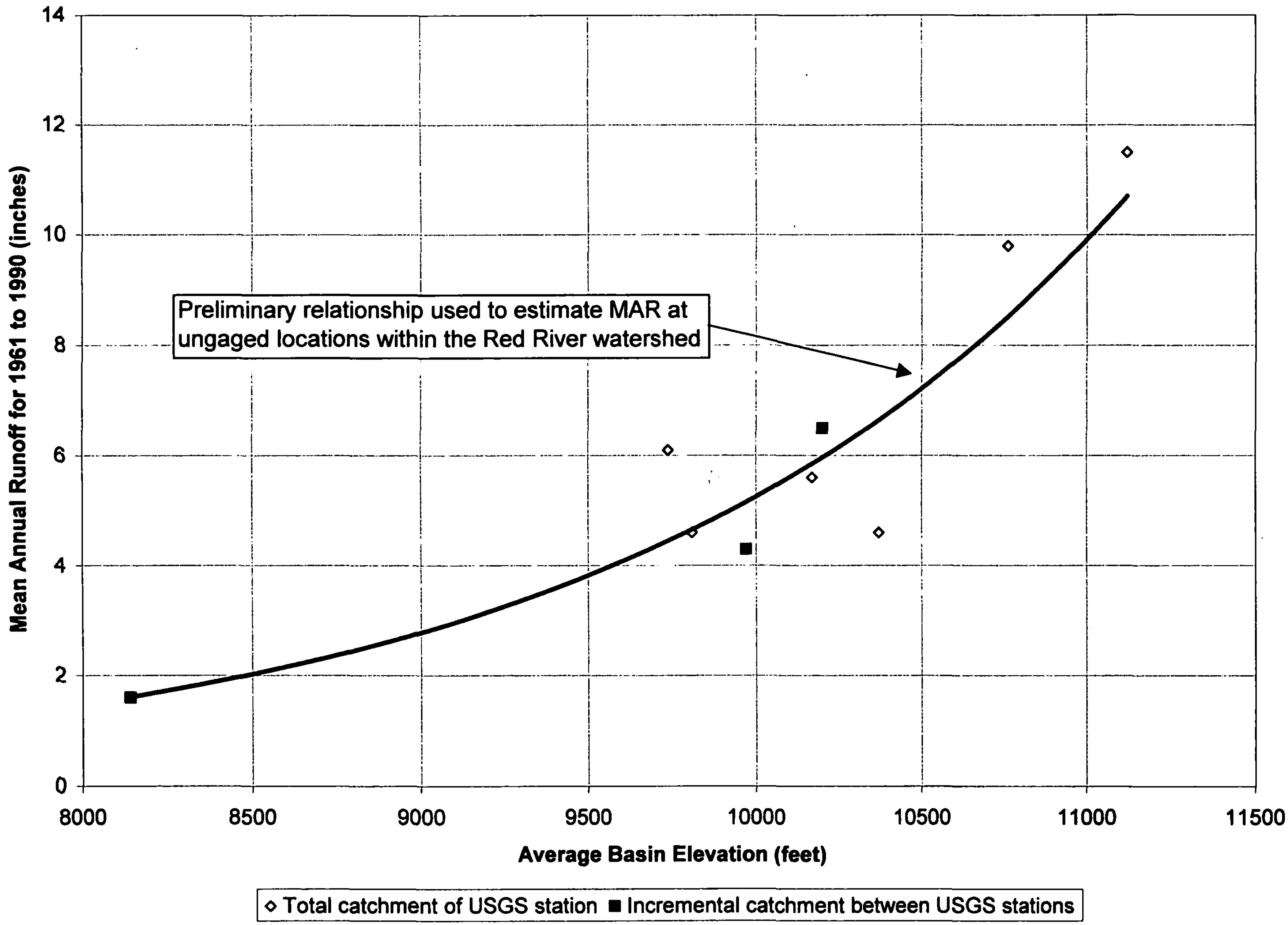
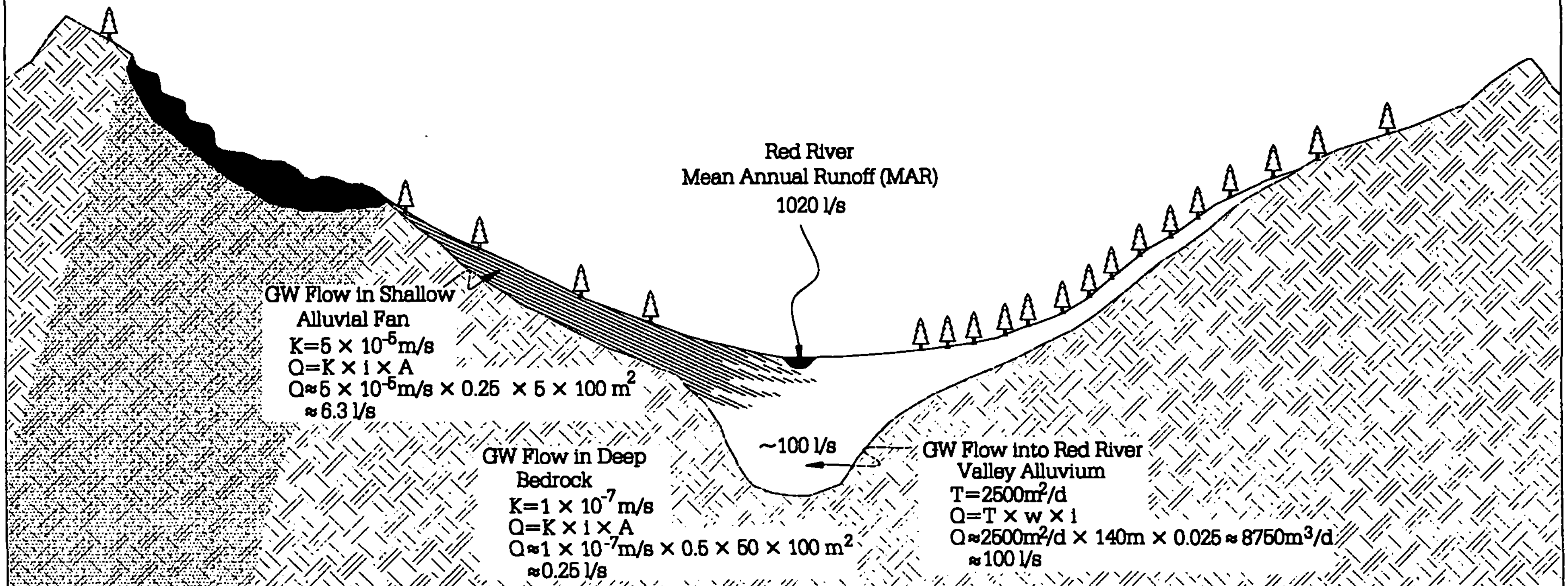


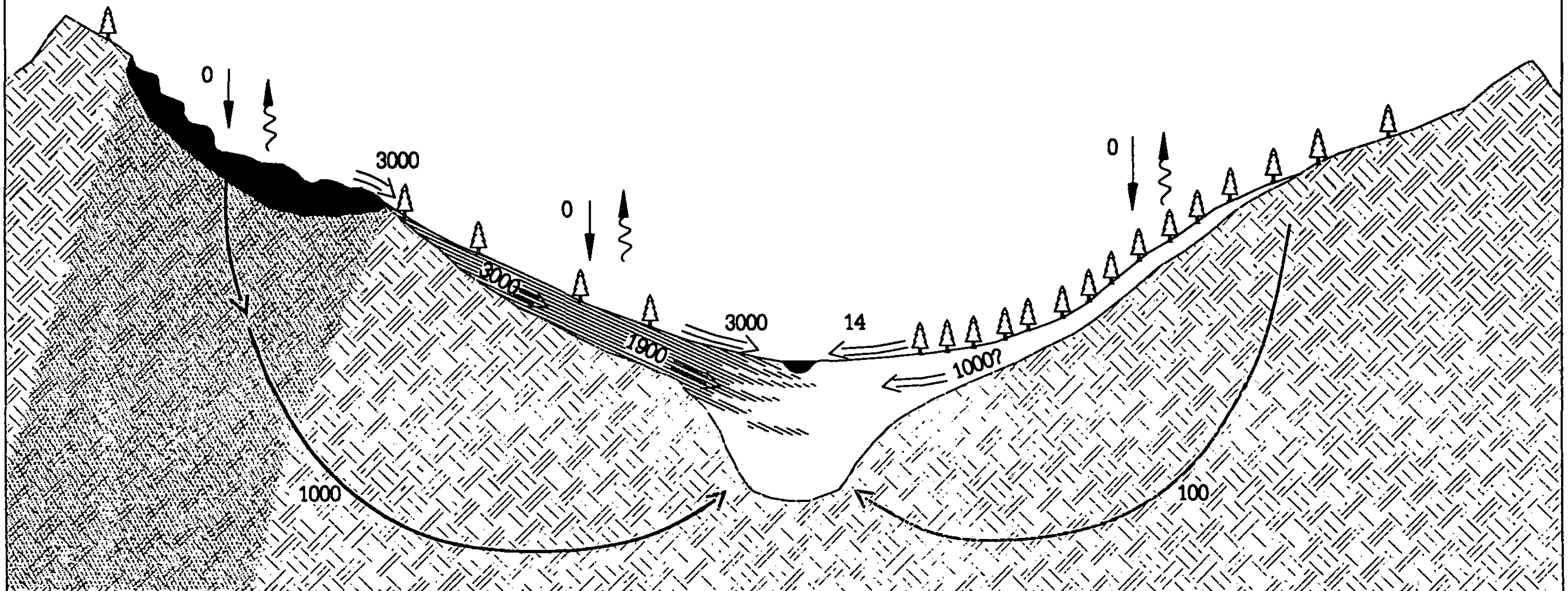
Figure 6. Regional Relationship Between MAR and Average Basin Elevation

Robertson GeoConsultants Inc
January 2000



Note: all estimates are preliminary and will be verified by field work

CLIENT:	MOLYCORP, INC.	ROBERTSON GEOCONSULTANTS INC. Consulting Geotechnical and Environmental Engineers	
PROJECT No:	052008		
PROJECT:	QUEASTA CLOSEOUT PLAN	Order of Magnitude Estimates of GW Flows	
LOCATION:	QUESTA MINE NEW MEXICO, USA	DATE: Jan. 2000	DRAWN BY: JG / FIGURE: 7



3000 [SO_4] in mg/l

	Scar Area	Fan	Total (into Red River System)	Non-scar Area
Surface Runoff	140 t/yr	0 t/yr	140 t/yr	0.5 t/yr
Groundwater Flow in alluvial soils	140 t/yr	57 t/yr	232 t/yr	35 t/yr
Groundwater Flow in bedrock	3 t/yr	0 t/yr	3.3 t/yr	0.3 t/yr
			375.8 t/yr	

Note: all estimates are preliminary and will be verified by field work

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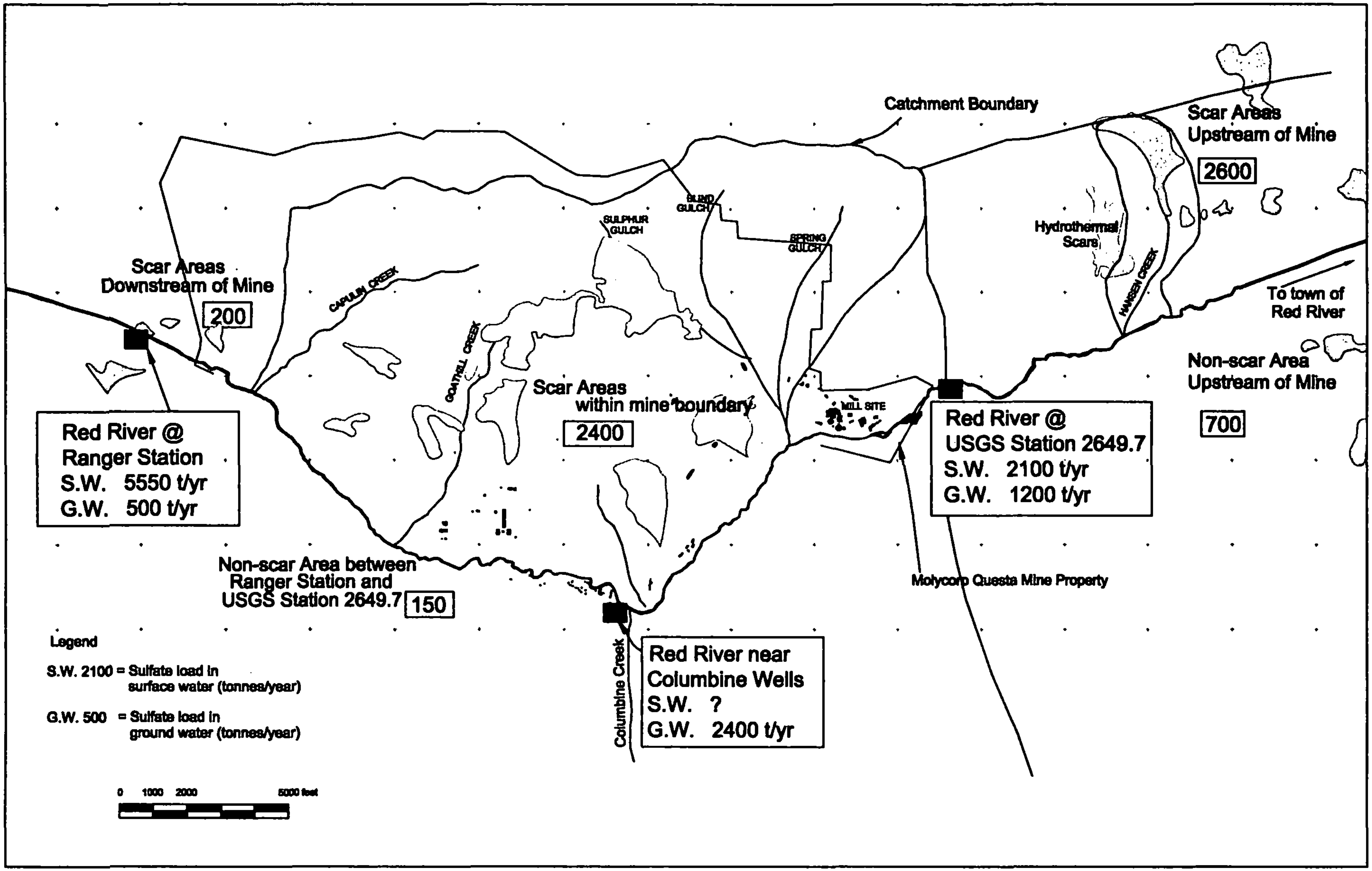
Hanson Creek - Local SO_4 Load Balance
(values are sulfate concentrations in mg/L)

DATE:	DRAWN BY:	FIGURE:
Jan. 2000	JG	8



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PROJECT:	QUESTA CLOSEOUT PLAN
LOCATION:	QUESTA MINE NEW MEXICO, USA

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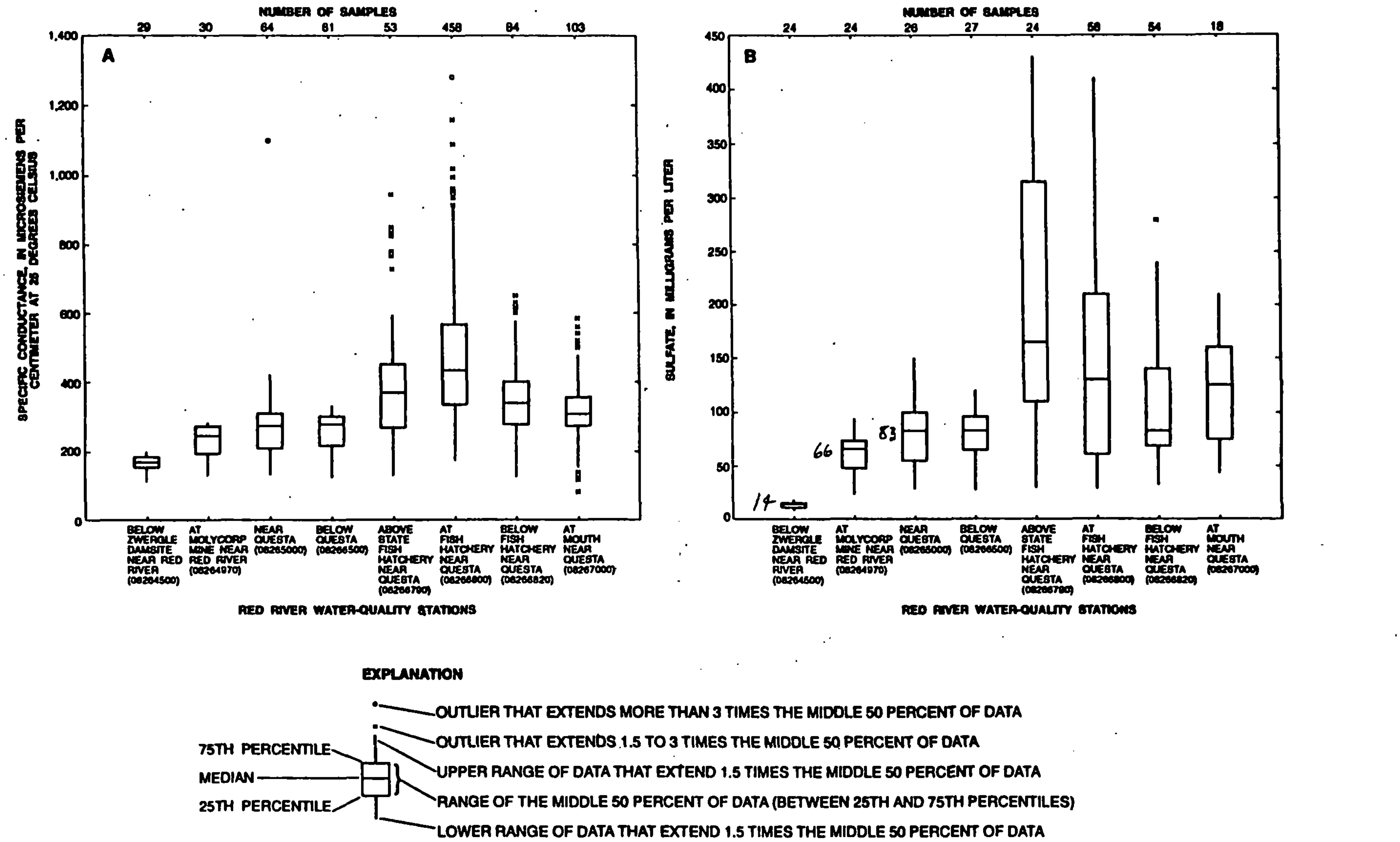
Pre-mining Annual Sulfate Load

DATE:	DRAWN BY:	FIGURE:
Jan. 2000	JG	9



CLIENT:	MOLYCORP, INC.
PROJECT No:	052008/1
PROJECT:	QUESTA CLOSEOUT PLAN
LOCATION:	QUESTA MINE NEW MEXICO, USA

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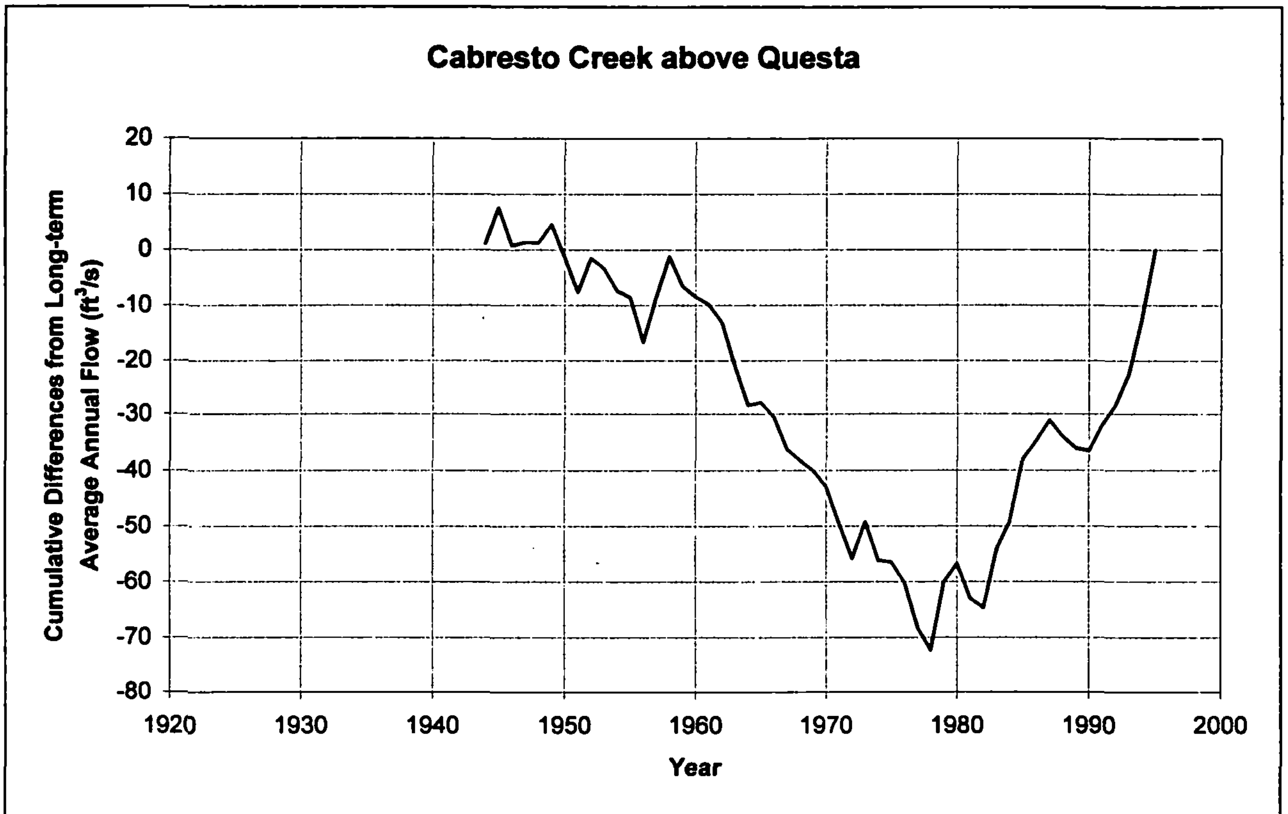
Selected Water Quality Properties and Constituents In the Red River: (A) specific conductance; (B) sulfate; (C) molybdenum; and (D) manganese.

DATE:	DRAWN BY:	FIGURE:
Jan. 2000	JG	10



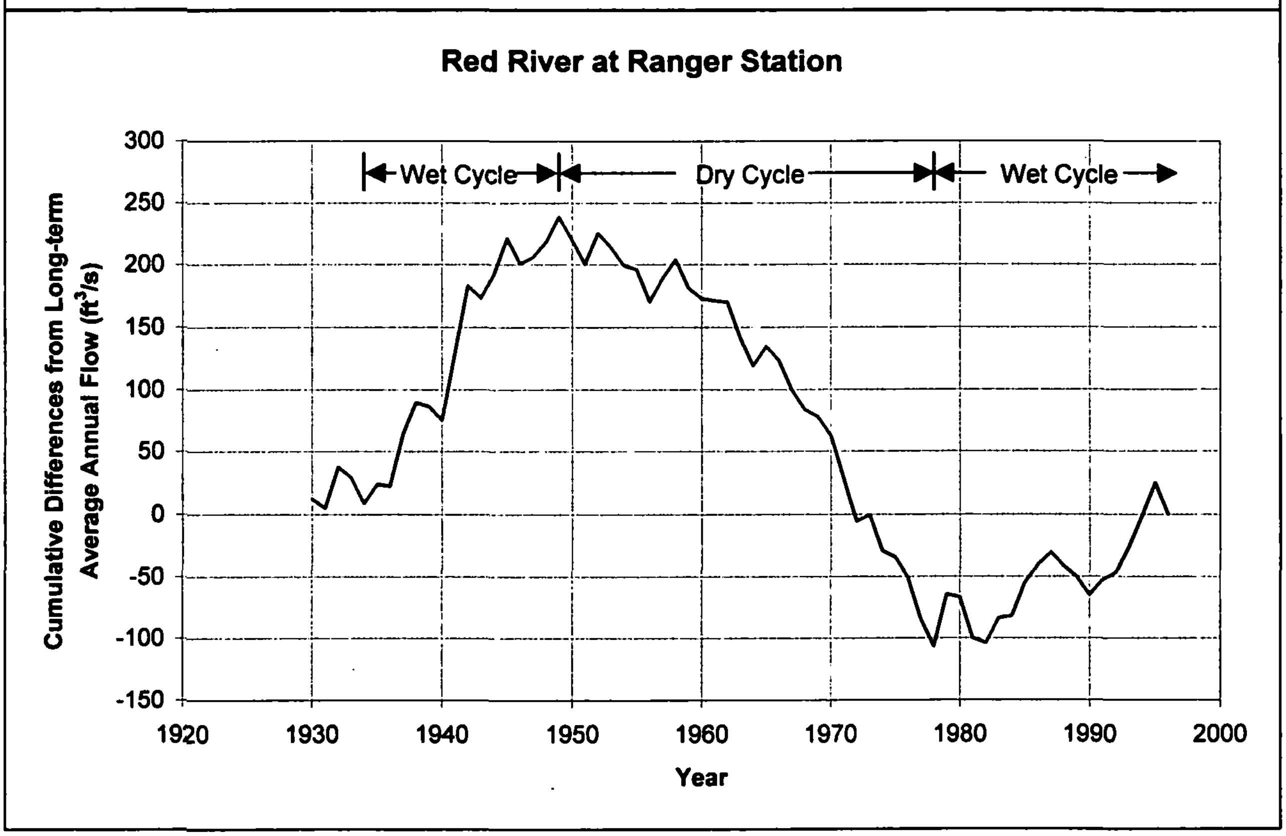
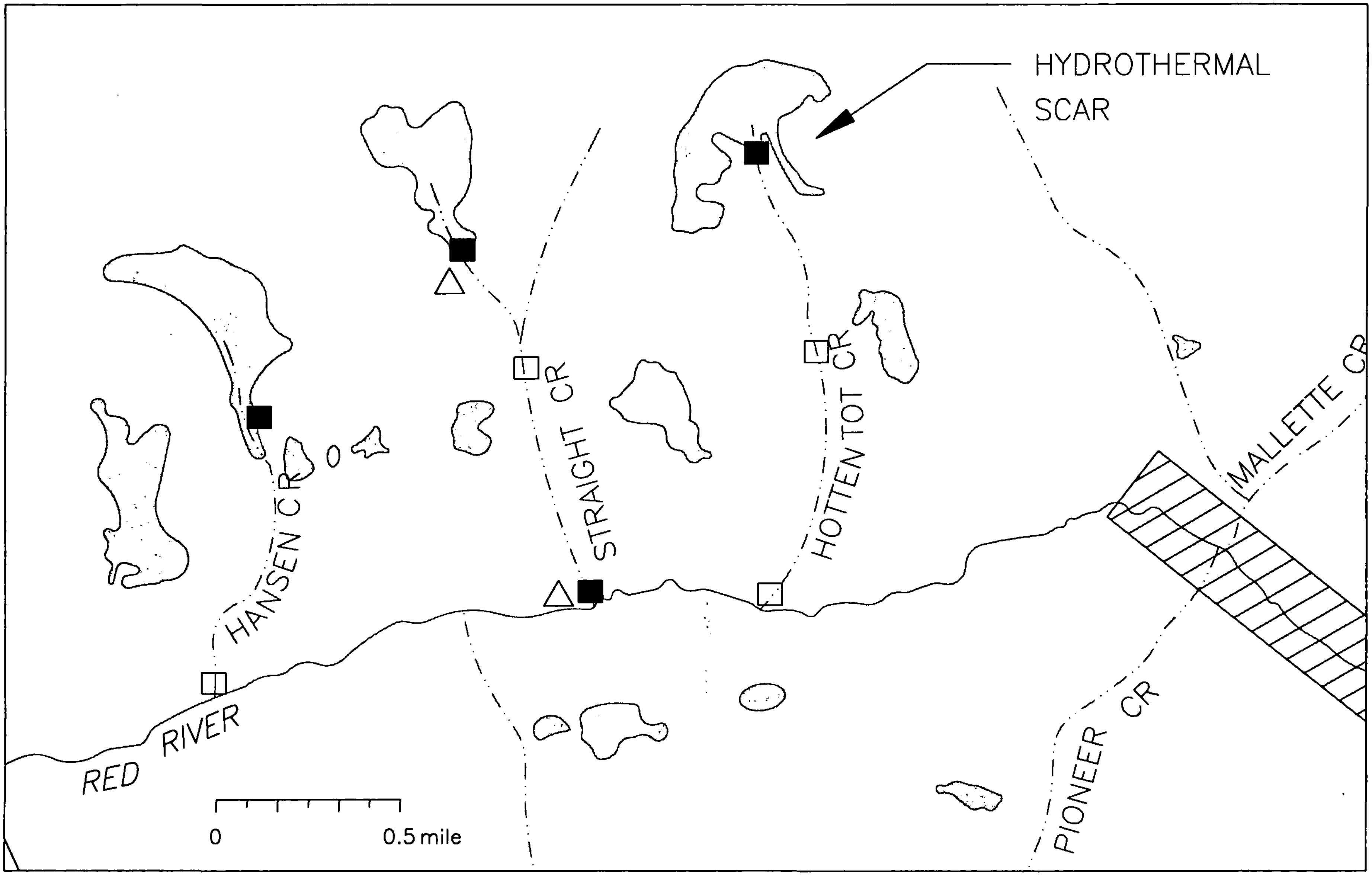


Figure 11. CUSUMS Plot for Cabresto Creek and Red River



Legend

- ■ Primary Surface Water Monitoring Station
- □ Secondary Surface Water Monitoring Station
- △ Rain Gauge

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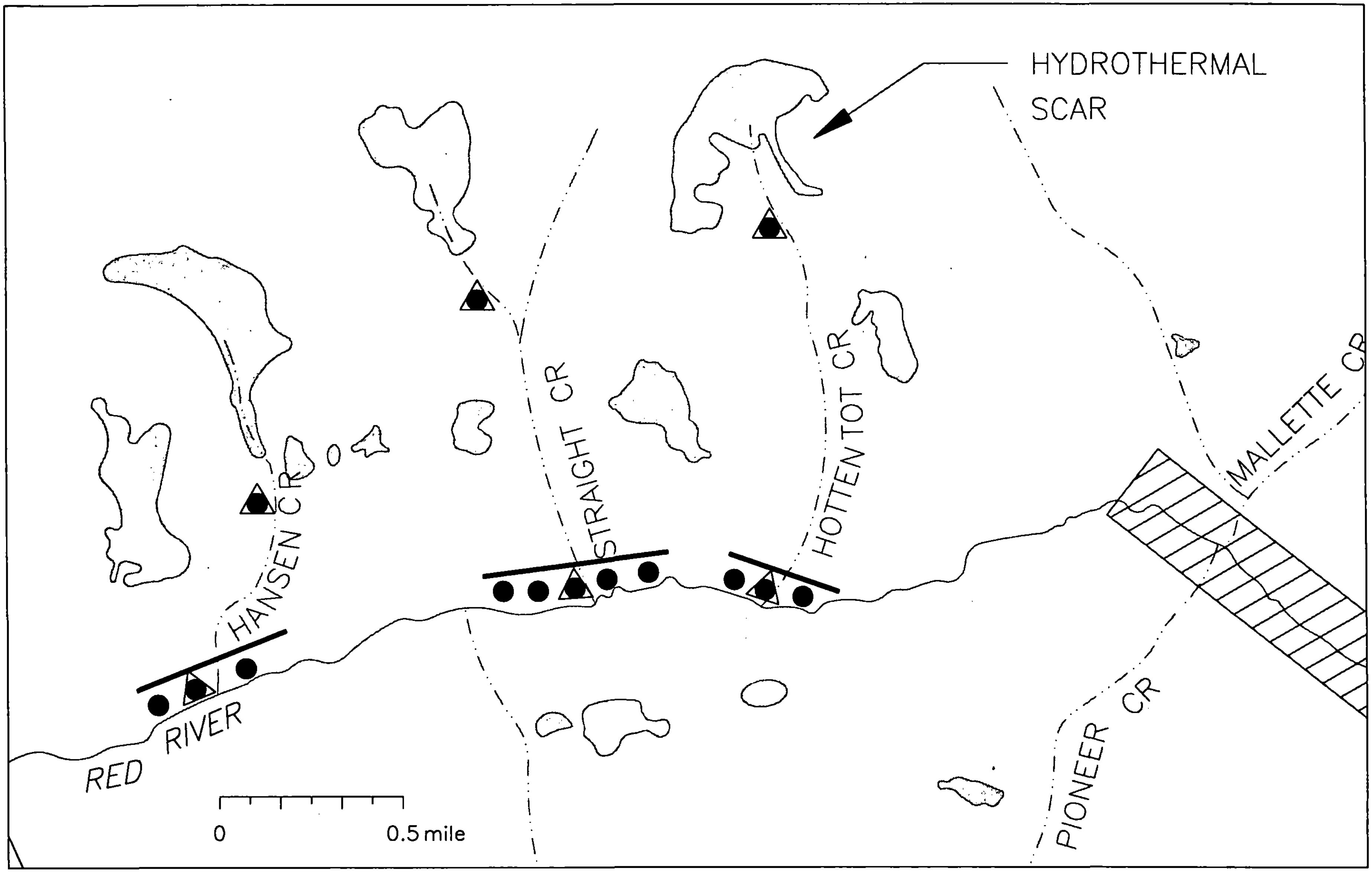
Proposed Locations for Surface Water Monitoring Stations

DATE:	DRAWN BY:	FIGURE:
Jan. 2000	JG	12



Legend

- ● Shallow well (completed in alluvium)
- △ Deep well (completed in bedrock)
- ▬ Geophysical Survey Lines

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PROJECT:	QUESTA CLOSEOUT PLAN
LOCATION:	QUESTA MINE NEW MEXICO, USA

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Proposed Locations for Groundwater Monitoring Wells

DATE:	DRAWN BY:	FIGURE:
Jan. 2000	JG	13

Appendix A

Schedule for development of Closeout Plan for Mine Site, Questa Mine, New Mexico

Table A1. Schedule for development of Closeout Plan for Mine Site - Questa Mine, New Mexico.

	Completed	01-Dec-99	15-Dec-99	01-Jan-00	15-Jan-00	01-Feb-00	15-Feb-00	01-Mar-00	15-Mar-00	01-Apr-00	15-Apr-00	01-May-00	15-May-00	01-Jun-00	15-Jun-00	01-Jul-00	15-Jul-00	01-Aug-00	15-Aug-00	01-Sep-00	15-Sep-00	01-Oct-00	15-Oct-00	01-Nov-00	15-Nov-00	01-Dec-00	15-Dec-00	01-Jan-01	15-Jan-01	projected date of completion (if after January 31, 2001)
Part 1: Framework for Review & Submission of Closeout Plan for Mine Site																														
Technical Review Round 1: Characterization & Scoping																														
-TRC & MAA Planning Meeting				Jan 13-14 (projected)																										
-Background Data Summary																														
-Development Data Summary																														
-Detailed Work Plans																														
-Draft Outline of Closeout Plan																														
-Meeting									March 31 (projected)																					
Technical Review Round 2: Alternatives Evaluation																														
-Design & Assessment of Alternative Control Measures																														
-Meeting																							October 16-17 (projected)							
-Additional Design & Assessment of Alternative Control Measures																														
Initial WQA (NMED) Public Hearing on DP 1055										April 3 (projected)																				
Submission of Modified Preliminary Closure Plan to NMED																					September 29									
Technical Review Round 3: Closeout Plan Options Review																														
-Closeout Plan Options Development																														
-MAA Meeting																										December 14-15 (projected)				
-Final Closeout Plan Preparation																														
Submission of Closeout Plan																													January 31 2001	
Submission of Supplementary Report to Closeout Plan																														May 31, 2001
WQA (NMED) Public Hearing on Modification of DP 1055																														July 31, 2001 (projected)
NMMA (MMD) Public Hearing on Closeout Plan																														August 1, 2001 (projected)
Submission of Financial Assurance Proposal (MMD)																														Oct 30, 2001
NMED Determination on Closeout Plan																														Nov 30, 2001 (projected)
Public Hearing on Financial Assurance Proposal (MMD)																														Nov 30, 2001 (projected)
Anticipated Approval of Closeout Plan, Financial Assurance in place (MMD)																														Dec 31, 2001 (projected)

Table A1. Schedule for development of Closeout Plan for Mine Site - Questa Mine, New Mexico.

	Completed	01-Dec-99	15-Dec-99	01-Jan-00	15-Jan-00	01-Feb-00	15-Feb-00	01-Mar-00	15-Mar-00	01-Apr-00	15-Apr-00	01-May-00	15-May-00	01-Jun-00	15-Jun-00	01-Jul-00	15-Jul-00	01-Aug-00	15-Aug-00	01-Sep-00	15-Sep-00	01-Oct-00	15-Oct-00	01-Nov-00	15-Nov-00	01-Dec-00	15-Dec-00	01-Jan-01	15-Jan-01	projected date of completion (if after January 31, 2001)
Part 2: Work Tasks under DP1055 (Mine Site)																														
A Characterization and Monitoring																														
A.1 Waste Rock Characterization																														
Phase 1 Initial investigation																														
Task 1.1 Review of mining history and mine records and determination of dump composition																														
Task 1.2 Site reconnaissance and mapping to define all sources (natural, mine disturbed and dumps)																														
Task 1.3 Phase 1 drilling and sampling program	C																													
Task 1.4 Instrumentation and monitoring	P																													– September 2001
Task 1.5 Phase 1 static and kinetic laboratory geochemical testing program	P																													– September 2001
Task 1.6 Phase 1 geotechnical/geohydrological testing program																														
Task 1.7 Phase 1 characterization and monitoring analyses and report									March 17																					
Task 1.8 Preliminary design and evaluation of closure measures																														
Phase 2 Investigation and Testing Program										March 31																				
Task 2.1 Phase 2 drilling and sampling program																														
Task 2.2 Phase 2 laboratory geochemical testing program																														
Task 2.3 Phase 2 geotechnical/geohydrological testing program																														
Task 2.4 Phase 2 characterization and monitoring analyses and report																				Aug 31										
Task 2.5 Design and evaluation of closure measures (Closeout Plan)																														Jan 31 2001
A.2 Geophysical Surveys																														
Task 1 Seismic and electrical resistivity profiles in vicinity of MMW-7																				Aug 31										
A.3 Installation of Monitoring Wells																														
Task 1.1 Installation of additional monitoring wells	C																													
A.4 Infiltration of storm water runoff																														

Table A1. Schedule for development of Closeout Plan for Mine Site - Questa Mine, New Mexico.

			Completed	01-Dec-99	15-Dec-99	01-Jan-00	15-Jan-00	01-Feb-00	15-Feb-00	01-Mar-00	15-Mar-00	01-Apr-00	15-Apr-00	01-May-00	15-May-00	01-Jun-00	15-Jun-00	01-Jul-00	15-Jul-00	01-Aug-00	15-Aug-00	01-Sep-00	15-Sep-00	01-Oct-00	15-Oct-00	01-Nov-00	15-Nov-00	01-Dec-00	15-Dec-00	01-Jan-01	15-Jan-01	projected date of completion (if after January 31, 2001)
	Task 1.1	Continued sampling required by Molycorp's Storm Water Pollution Prevention Plan																														ongoing
	Task 1.2	Calculation of potential impact on ground water quality by storm water runoff																														
A.5	Surface and ground water quality monitoring																															
	Task 1.1	Monthly gauging of monitoring wells																														ongoing
	Task 1.2	Bi-annually sampling and water quality analysis																														ongoing
A.6	Reporting of regular monitoring well data																															
	Task 1.1	All available gauging and water quality results from the mine monitoring wells forwarded to	C																													
A.7	Background Characterization Study																															
	Phase 1																															
	Task 1.1	Reconnaissance survey						Jan 31																								
	Task 1.2	Historical and anthropological use determination																														
	Task 1.3	Surface water monitoring																														May 2001
	Task 1.4	Report on background characterization of surface water from non-mining scar affected areas																							Oct 16							
	Phase 2							Jan 31																								
	Task 2.1	Ground water reconnaissance survey																														
	Task 2.2	Ground water quality monitoring																														May 2001
	Task 2.3	Background characterization of groundwater from non-mining scar affected areas (w/ drilling)																Jul 17														
	Task 2.4	Reconnaissance survey of all scar areas																														
	Task 2.5	Watershed baseline contaminant load model																										Dec 15			
A.8	GSI/Water from the P-series of wells																															
	Task 1.1	Submit data	C																													

Table A1. Schedule for development of Closeout Plan for Mine Site - Questa Mine, New Mexico.

			Completed	01-Dec-99	15-Dec-99	01-Jan-00	15-Jan-00	01-Feb-00	15-Feb-00	01-Mar-00	15-Mar-00	01-Apr-00	15-Apr-00	01-May-00	15-May-00	01-Jun-00	15-Jun-00	01-Jul-00	15-Jul-00	01-Aug-00	15-Aug-00	01-Sep-00	15-Sep-00	01-Oct-00	15-Oct-00	01-Nov-00	15-Nov-00	01-Dec-00	15-Dec-00	01-Jan-01	15-Jan-01	projected date of completion (if after January 31, 2001)
A.9		**Report Submittals**																														
	Task 1.1	Submit 1997 reports by TRC Environmental Solutions Inc., Schafer & Associates and Chadwick Ecological Consultants Inc.	C																													
A.10		**Water Balance for Waste Dumps**																														
	Phase 1	*Water balance for three representative dumps*																														
	Task 1.1	Select waste rock types; analyze soil characteristics; finalize design (with modeling) submit work plan for cover test plot construction	P							Feb 29																						
	Task 1.2	Install plots and met station; set-up and data acquisition system																														
	Task 1.3	Preparation of As-Built Report																June 30														
	Task 1.4	Monitoring																														
	Task 1.5	Initial review of model calibration, recommendation for changes (if required)																														
	Task 1.6	Monitoring																														June 2001
	Task 1.7	Calibration of soil-atmosphere model																							Oct 16							
	Task 1.8	Water balance calculations																														
	Phase 2	*Water balance for all dumps*																														
	Task 2.1	Water balance calculations																											Dec 15			
A.11		**Comprehensive Hydrological Balance**																														
	Phase 1	*Natural contaminated drainage site detailed hydrological balance*						Jan 31																								
	Task 1.1	Surface water characterization and model																														
	Task 1.2	Groundwater characterization and model																														
	Task 1.3	Integrated geochemical load balance																											Dec 15			
	Phase 2	*Mine detailed hydrological balance*						Jan 31																								
	Task 2.1	Surface water characterization and model																														
	Task 2.2	Groundwater characterization and model																														

Table A1. Schedule for development of Closeout Plan for Mine Site - Questa Mine, New Mexico.

			Completed	01-Dec-99	15-Dec-99	01-Jan-00	15-Jan-00	01-Feb-00	15-Feb-00	01-Mar-00	15-Mar-00	01-Apr-00	15-Apr-00	01-May-00	15-May-00	01-Jun-00	15-Jun-00	01-Jul-00	15-Jul-00	01-Aug-00	15-Aug-00	01-Sep-00	15-Sep-00	01-Oct-00	15-Oct-00	01-Nov-00	15-Nov-00	01-Dec-00	15-Dec-00	01-Jan-01	15-Jan-01	projected date of completion (if after January 31, 2001)
	Task 2.3	Integrated geochemical load balance																											Dec 15			
	Phase 3	*Tailings detailed hydrological balance(see Schedule for Tailings Facility)*																														
	Phase 4	*Red River basin system description*						Jan 31																								
	Task 4.1	Surface water characterization and model																														
	Task 4.2	Groundwater characterization and model																														
	Task 4.3	Integrated geochemical load balance																											Dec 15			
B	**Abatement of Existing Ground and Surface Water Contamination**																															
C	**Contingency Plan**																															
C.1	**Submittal of Contingency Plan**																															
	Task 1.1	Submit plan (revisions to plan)	P																			Aug 31										
D	**Closure Plan and Financial Assurance Plan**																															
D.1	**Revegetation Program**																															
	Task 1.1	Continue implementation and research program with Revegetation Success & Establishment Report																														April 2001
D.2	**Closure Plan**																															
	Task 1.1	Determine what, if any additional measures are required for the Closeout Plan																						Sep 30								
D.3	**Post-Closure Hydrologic Model**																															
	Task 1.1	Assess mine post-closure impacts to ground water and surface water																														
	Task 1.2	Develop and refine dynamic hydrologic model																														
D.4	**Interim Financial Assurance Plan**																															
	Task 1.1	Provide financial assurance plan pursuant to Water Quality Act	P				Jan 14 (projected)																									

Table A1. Schedule for development of Closeout Plan for Mine Site - Questa Mine, New Mexico.

		Completed	01-Dec-99	15-Dec-99	01-Jan-00	15-Jan-00	01-Feb-00	15-Feb-00	01-Mar-00	15-Mar-00	01-Apr-00	15-Apr-00	01-May-00	15-May-00	01-Jun-00	15-Jun-00	01-Jul-00	15-Jul-00	01-Aug-00	15-Aug-00	01-Sep-00	15-Sep-00	01-Oct-00	15-Oct-00	01-Nov-00	15-Nov-00	01-Dec-00	15-Dec-00	01-Jan-01	15-Jan-01	projected date of completion (if after January 31, 2001)
Part 3: Additional Studies for Close-Out Planning																															
E	**Additional Studies - Mine Site**																														
Study E1	Surface Erosion & Stability Analysis (Work Plan, Investigation & Report)				Dec 31															Aug 16											
Study E2	Rooting Zone and Cover Evaluation (Work Plan, Investigation & Report)						Jan 31																Oct 16								
Study E3	Borrow Materials Investigation (Work Plan, Investigation & Report)						Jan 31																Oct 16								
Study E4	Wildlife Impact Study (Work Plan, Investigation & Report)								Feb 29																						April 2001
Study E5	Open Pit Waiver Information (Work Plan, Investigation & Report)						Jan 31																								April 2001
Study E6	Subsidence Area Waiver Information (Work Plan, Investigation & Report)						Jan 31																								April 2001
Study E7	Vegetation Test Plot (Work Plan)						Jan 31																								

Code:

- ▲ Workplan
- ■ Report
- ● Projected Meeting/Hearing
- C Work Task completed
- P Work Task partially completed
- ——— Duration of Specified Task
- — — Duration of Specified Task (weather permitting)

Note: Work Plan and report submittal dates are the dates of first submittal by Molycorp. It is assumed that no more than one month will be required after submittal for workplan or report acceptance.

Table A2. Schedule for development of Closeout Plan for Tailings Facility - Questa Mine, New Mexico.

	Completed	01-Dec-99	15-Dec-99	01-Jan-00	15-Jan-00	01-Feb-00	15-Feb-00	01-Mar-00	15-Mar-00	01-Apr-00	15-Apr-00	01-May-00	15-May-00	01-Jun-00	15-Jun-00	01-Jul-00	15-Jul-00	01-Aug-00	15-Aug-00	01-Sep-00	15-Sep-00	01-Oct-00	15-Oct-00	01-Nov-00	15-Nov-00	01-Dec-00	15-Dec-00	01-Jan-01	15-Jan-01	projected date of completion (if after January 31, 2001)
Part 1: Framework for Review & Submission of Closeout Plan for Tailings Facility																														
Questa Tailings Facility Revised Closure Plan submitted	■	May 1, 1998																												
WQA (NMED) Public Hearing on DP 933 Modification																	● July 31, 2000 (projected)													
NMMA (MMD) Public Hearing on Tailings Closeout Plan																		● Aug 1, 2000 (projected)												
NMED Determination on Closeout Plan																									● Nov 30, 2000 (projected)					
Submission of Financial Assurance Proposal (MMD)																					■ Sep 29, 2000 (projected)									
Public Hearing on Financial Assurance Proposal (MMD)																								● Nov 15, 2000 (projected)						
Anticipated Approval of Closeout Plan, Financial Assurance in place (MMD)																											● Dec 29, 2000 (projected)			
Part 2: Work Tasks under DP1055																														
A Characterization and Monitoring																														
A.11 Comprehensive Hydrological Balance																														
Phase 3 Tailings detailed hydrological balance					▲ Jan 31																									
Task 3.1 Surface water characterization and model	P																													
Task 3.2 Groundwater characterization and model	P																													
Task 3.3 Integrated geochemical load balance	P												■ May 31																	
Part 3: Work Tasks under DP 933 (Tailings Facility)																														
A Characterization and Monitoring																														
Task A1 Tailings Revegetation (Work Plan, Investigation & Report)							▲ Feb 29																							■ April 2001

Table A2. Schedule for development of Closeout Plan for Tailings Facility - Questa Mine, New Mexico.

	Completed	01-Dec-99	15-Dec-99	01-Jan-00	15-Jan-00	01-Feb-00	15-Feb-00	01-Mar-00	15-Mar-00	01-Apr-00	15-Apr-00	01-May-00	15-May-00	01-Jun-00	15-Jun-00	01-Jul-00	15-Jul-00	01-Aug-00	15-Aug-00	01-Sep-00	15-Sep-00	01-Oct-00	15-Oct-00	01-Nov-00	15-Nov-00	01-Dec-00	15-Dec-00	01-Jan-01	15-Jan-01	projected date of completion (if after January 31, 2001)
Task A2 Tailings Cover Test Plot Study (Work Plan, Investigation & Report)						Jan 31																								June 2001
Part 4: Additional Studies for Close-Out Planning																														
B Additional Studies - Tailings																														
Study B1 Surface Erosion & Stability Analysis (Work Plan, Investigation & Report)				Dec 31										May 31																
Study B2 Borrow Materials Investigation (Work Plan, Investigation & Report)						Jan 31								May 31																
Study B3 Wildlife Impact Study (Work Plan, Investigation & Report)								Feb 29						May 31																

Code:

- ▲ Workplan
- ■ Report
- ● Projected Meeting/Hearing
- C Work Task completed
- P Work Task partially completed
- ——— Duration of Specified Task
- — — Duration of Specified Task (weather permitting)

Note: Work Plan and report submittal dates are the dates of first submittal by Molycorp. It is assumed that no more than one month will be required after submittal for workplan or report acceptance.

Appendix B

List of Proposed Water Quality Analyses, Detection Limits an Sample Handling Procedures

ACZ Laboratories, Inc.

20 January 2000

Christof Wels
Robertson Geo Consultants
Ste. 330 580 Hornsby
Vancouver, BC Canada
Ph: 604-684-8072 Fax: 604-684-8073

RE: MolyCorp Bid

Dear Mr. Wels,

Thank you for giving us at ACZ the opportunity to bid on this MolyCorp project. Because you have not worked with us previously, I want to take the time to outline a few details for you.

If you would like me to make any changes on the following bid, CJV131, please let me know. I would be happy to adjust detection levels and/or parameters at your request. ACZ ships all containers pre-preserved via UPS ground service at our cost. Return shipping is the responsibility of the client. Our standard Electronic Data Deliverable format is Microsoft Access. If you would like a custom format EDD, please let us know as soon as possible, and we will modify the price structure if necessary.

ACZ's commitment to data quality is illustrated in our achievements in performance evaluation (P.E.) studies. Results from ACZ's EPA Water Pollution and Water Supply P.E. studies are provided in the appendices of the SOQ. Additionally ACZ participates in Analytical Standards Inc. (ASI) quarterly double blind P.E. studies. The majority of the top laboratories in the industry participate in these ASI studies. In the six past studies ACZ has scored a perfect 100% on the metals analysis, a feat unmatched by in other laboratory in the history of the program. ACZ also was recently ranked in the top 10 labs nationwide in the study. A summary of ACZ's performance in this ASI study will be provided upon request.

If you have any immediate questions, please call me at 1-800-335-5493. If you would like me to send you our Statement of Qualifications (SOQ), please let me know and I will get it in the mail for you. Once again, thank you for the opportunity to bid on this project.

Sincerely,

Christy Van Campen

Christy Van Campen
Client Services Representative/Chemist

Encl.

ACZ Laboratories, Inc.

Christof Wels
Robertson Geo Consultants
Ste. 330 580 Hornby St.
Vancouver, BC Canada
Ph: 604-684-8072 Fax: 604-684-8073

27 January 2000

Re: ACZ Methodology and Detection Limits

Parameter	**Method**	**Detection Limit**
Matrix: Groundwater		
Alkalinity (includes HCO3, CO3, OH)	EPA M310.1	2.0 mg/L
Acidity	EPA M305.1	2.0 mg/L
Chloride	EPA M352.2	1.0 mg/L
Electroconductivity	EPA M120.1	1 umhos/cm
Fluoride	EPA M340.2	0.1 mg/L
Hardness	SM 2340B (Calc.)	1.0 mg/L
Ph	EPA M150.1	0.1 units
Sulfate	EPA M375.4	1.0 mg/L
Total Dissolved Solids	EPA M160.1	10 mg/L
Dissolved Metals:		
Aluminum	EPA M200.7 ICP	30 ug/L
Cadmium	EPA M200.8 ICP/MS	0.1 ug/L
Calcium	EPA M200.7 ICP	200 ug/L
Cobalt	EPA M200.8 ICP/MS	0.05 ug/L
Copper	EPA M200.8 ICP/MS	0.5 ug/L
Iron	EPA M200.7 ICP	10 ug/L
Magnesium	EPA M200.7 ICP	200 ug/L
Manganese	EPA M200.7 ICP	5.0 ug/L
Nickel	EPA M200.8 ICP/MS	0.2 ug/L
Potassium	EPA M200.7 ICP	300 ug/L
Sodium	EPA M200.7 ICP	300 ug/L
Zinc	EPA M200.9 GFAA	1.0 ug/L

ACZ Laboratories, Inc.

30400 Downhill Drive
Steamboat Springs, CO 80487-9400
(303) 879-6590 (800) 334-5493
FAX No. (303) 879-2216

Additional Comments:

- Please fill out Chain-of-Custody Forms completely including: Name, Billing Address, Telephone Number, Project Number (if applicable), and Analyses Requested. This helps to ensure accurate and timely analysis of your samples.
- Clean field debris from the sample container exterior to lessen the chance of contamination.
- All samples should be cooled to 4 C for transport to ACZ Laboratories, Inc.
- Please contact us before shipping any samples which have 24 hour holding times [e.g., Coliforms or BOD] so that we may assist with sample transport and schedule the analyses to ensure holding times are met.
- Pack glass containers with adequate foam, bubble wrap, or other packing material (UPS recommends four [4] inches on each side) to prevent breakage.
- Filtered samples (except DOC) should be passed through a 0.45 um membrane filter before acidification. DOC samples should be passed through a 0.45 um silver mesh filter.
- We include sample labels for your convenience. Please use a waterproof marker for writing on labels and properly attach labels to bottles.
- Samples should be shipped to ACZ Laboratories, Inc. on the same day as taken. Please notify us if samples are shipped on Friday for Saturday delivery.
- Please contact us with any sample analyses, sample preservation, or sample transportation questions.

ACZ

Inorganic Water Sample Bottle & Preservation Information

Color Coding:	None	White	Red	Green	Yellow	Yellow (Glass)	Blue	Blue (Glass)	Tan	Orange	Purple	Sterile
Letter Code:	U	W	R	G	Y	YG	B	BG	T	O	P	ST
Sample Type:	Raw	Filtered	Raw	Filtered	Raw	Raw	Filtered	Filtered	Raw	Raw	Raw	Raw
Preservative:	None	None	Nitric Acid	Nitric Acid	Sulfuric Acid	Sulfuric Acid	Sulfuric Acid	Sulfuric Acid	NaOH & Zinc Acetate	Sulfuric Acid	Sodium Hydroxide	Sodium Thiosulfate
Preservative Volume:	None	None	2 ml 50% Nitric	1 ml 50% Nitric	1 ml 25% Sulfuric	2 ml 25% Sulfuric	2 ml 25% Sulfuric	2 ml 25% Sulfuric	1 ml 5N NaOH 1 ml 2N Zinc Acetate	8ml 25% H_2SO_4	10 ml 5N NaOH	Sodium Thiosulfate Tablet
Bottle Type:	Plastic	Plastic	Plastic	Plastic	Plastic	Glass	Plastic	Glass	Plastic	Glass	Plastic	Plastic
Bottle Volume:	250 - 500 ml and 50 ml Tube	250 ml	250 ml	125 ml	125 ml	250 ml	125 ml	250 ml	125 ml	1000 ml	500 ml -1000 ml	125 ml
Analyses:	Acidity Alkalinity (Bicarbonate, Carbonate, Hydroxide) BOD Chlorine Color Conductivity Odor Orthophosphate pH Solids: Settleable (1L) Suspended Volatile TDS & TSS - (If run together) Sulfite Surfactants Suspended Sediment Turbidity	Bromide Chloride Chromium VI Fluoride Iodide (24 hour H/T) Nitrogen: Nitrate (calc.) (48 hour H/T) Calc. Needs: Nitrate/Nitrite & Nitrite Orthophosphate: (Dissolved Only) Silica Solids: (Dissolved - if TDS only) Sulfate	Metals: (Total Only) Metals: (Total Recov- erable)	Metals: (Dissolved Only) Dissolved Cations: Boron Calcium Magnesium Potassium Sodium Thiocyanate	* Nitrogen: Total Ammonia Nitrate/Nitrite (28 Day H/T) * Phosphorus: (Total Only)	COD (Total Only) Phenols: (Total Only) TOC * Nitrogen: Total Ammonia Organic * Phosphorus: (Total Only) TOX (500ml)	* Nitrogen: Disolved Ammonia * Phosphorus: (Dissolved Only)	COD (Dissolved Only) Phenols: (Dissolved Only) * Phosphorus: (Dissolved Only) DOC * Nitrogen: (Dissolved Only)	Sulfide	Oil & Grease	Cyanide: Free Total WAD Ammenable to Chlorine	Coliforms: Fecal Total (24 hour H/T) (No color coding on this bottle)

*** Parameters may be analyzed from either glass or plastic containers.**
H/T - Hold Times

WATER AND WASTEWATER

INORGANIC PARAMETER HOLDING TIMES

Parameter	Sample Container	Preservation Technique	Sample Transport	Holding Time (days)
Acidity	Plastic	Refrigeration	Cool to 4 C	14
Alkalinity	Plastic	Refrigeration	Cool to 4 C	14
BOD	Plastic	Refrigeration	Cool to 4 C	48 hrs.
Boron	Plastic			28
Bromide	Plastic			28
COD	Glass/Teflon	Sulfuric Acid to pH $\leq$ 2	Cool to 4	28
Chlorine	Plastic			Immed.
Chloride	Plastic	None Required		28
Color	Plastic	Refrigeration	Cool to 4 C	48 hrs.
Conductivity	Plastic	Refrigeration	Cool to 4 C	28
Cyanide:				
Total	Plastic	NaOH to pH $\geq$ 12 (Dark)	Cool to 4 C	14
Free	Plastic	NaOH to pH $\geq$ 12 (Dark)	Cool to 4 C	14
WAD	Plastic	NaOH to pH $\geq$ 12 (Dark)	Cool to 4 C	14
Fluoride	Plastic			28
Iodide	Plastic	Refrigeration	Cool to 4 C	24 hrs.
Hardness:				
Calcium & Magnesium	Plastic	Nitric Acid to pH $\leq$ 2		180
Nitrogen:				
Ammonia	Plas./Glass	Sulfuric Acid to pH $\leq$ 2	Cool to 4 C	28
NO3/NO2	Plas./Glass	Sulfuric Acid to pH $\leq$ 2	Cool to 4 C	28
Nitrate	Plastic	Refrigeration	Cool to 4 C	48 hrs.
Nitrite	Plastic	Refrigeration	Cool to 4 C	48 hrs.
Total	Plas./Glass	Sulfuric Acid to pH $\leq$ 2	Cool to 4 C	28
Oil & Grease	Glass (1-ltr)	Sulfuric Acid to pH $\leq$ 2	Cool to 4 C	28
Organic Carbon:				
TOC	Glass	Sulfuric Acid to pH $\leq$ 2	Cool to 4 C	28
DOC	Glass	Sulfuric Acid to pH $\leq$ 2	Cool to 4 C	28
pH	Plastic			Immediate
Phenols:				
Dissolved	Glass	Sulfuric Acid to pH $\leq$ 2	Cool to 4 C	28
Total	Glass	Sulfuric Acid to pH $\leq$ 2	Cool to 4 C	28
Phosphorus:				
Hydroloze	Plas./Glass	Sulfuric Acid to pH $\leq$ 2	Cool to 4 C	28
Orthophosphate, Dissolved	Plas./Glass	Refrigeration	Cool to 4 C	48 hrs.
Total	Glass	Sulfuric Acid to pH $\leq$ 2	Cool to 4 C	28
Total, Dissolved	Plastic/Glass	Refrigeration	Cool to 4 C	48 hrs.
Silica	Plastic		Cool to 4 C	28
Sodium	Plastic	Refrigeration	Cool to 4 C	180
Solids:				
Dissolved	Plastic	Refrigeration	Cool to 4 C	7
Settleable	Plastic	Refrigeration	Cool to 4 C	48 hrs.
Suspended	Plastic	Refrigeration	Cool to 4 C	7
Total	Plastic	Refrigeration	Cool to 4 C	7
Volatile	Plastic	Refrigeration	Cool to 4 C	7
Sulfate	Plastic	Refrigeration	Cool to 4 C	28
Sulfide	Plastic	Zinc Acetate + NaOH to pH $\geq$ 9	Cool to 4 C	7
Sulfite	Plastic	1-ml of 2.5% EDTA solution	Cool $\leq$ 50 C	Immediate
Surfactant	Plastic	Refrigeration	Cool to 4C	48hrs
Susp. Seds.	Plastic	None Required	Cool to 4 C	
Turbidity	Plastic	Refrigeration (Dark)	Cool to 4 C	48 hrs.